16:10:05 OCA PAD AMENDMENT - PROJECT HEADER INFORMATION 03/25/92

Active

Project #: G-35-607
Center # : R6305-0A0

Cost share #:
Center shr #:

Rev #: 10
OCA file #:
Work type : RES

Contract#: NAS1-18487 Mod #: 6
Prime #:

Document : CONT
Contract entity: GTRC

Subprojects ? : N
Main project #:

CFDA: N/A
PE #: R11743

Project unit: E & A SCI Unit code: 02.010.140
Project director(s):
CUNNOLD D M E & A SCI (404)894-3814

Sponsor/division names: NASA / LANGLEY RESEARCH CTR, VA
Sponsor/division codes: 105 / 001

Award period: 870415 to 930414 (performance) 930414 (reports)

Sponsor amount	New this change	Total to date
Contract value	0.00	370,301.00
Funded	58,796.00	370,301.00
Cost sharing amount		0.00

Does subcontracting plan apply ?: N

Title: INVESTIGATIONS OF SAGE II OZONE AND NO2 MEASUREMENTS

PROJECT ADMINISTRATION DATA

OCA contact: Ina R. Lashley 894-4820

Sponsor technical contact

G.L. MADDREA, MAIL STOP 475 7
(804)865-2065

NASA
LANGLEY RESEARCH CENTER
HAMPTON VA 23665-5225

Sponsor issuing office 5

SANDRA D. MURACA, MAIL STOP 126
(804)865-2524

NASA
LANGLEY RESEARCH CENTER
HAMPTON VA 23665-5225

Security class (U,C,S,TS) : U
Defense priority rating : NA
Equipment title vests with: Sponsor GIT X
<$5,000 W/GIT BUT REQUIRES PRIOR APPROVAL OF PCO.

ONR resident rep. is ACO (Y/N): Y
GOVT supplemental sheet

Administrative comments -
AMENDMENT 6 AUTHORIZES FINAL INCREMENT OF $58,796 THRU 4/14/93.

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 05/03/93

Project No. G-35-607 Center No. R6305-0A0

Project Director CUNNOLD D M School/Lab E & A SCI

Sponsor NASA/LANGLEY RESEARCH CTR, VA

Contract/Grant No. NAS1-18487 Contract Entity GTRC

Prime Contract No. ____________

Title INVESTIGATIONS OF SAGE II OZONE AND NO2 MEASUREMENTS

Effective Completion Date 930414 (Performance) 930414 (Reports)

Closeout Actions Required:	Y/N	Date Submitted
Final Invoice or Copy of Final Invoice	Y	
Final Report of Inventions and/or Subcontracts	Y	
Government Property Inventory & Related Certificate	Y	
Classified Material Certificate	N	
Release and Assignment	N	
Other ____________	N	

CommentsEFFECTIVE DATE 4-15-87. CONTRACT VALUE $370,301

Subproject Under Main Project No. ____________

Continues Project No. ____________

Distribution Required:	
Project Director	Y
Administrative Network Representative	Y
GTRI Accounting/Grants and Contracts	Y
Procurement/Supply Services	Y
Research Property Managment	Y
Research Security Services	N
Reports Coordinator (OCA)	Y
GTRC	Y
Project File	Y
Other CARL BAXTER-FMD	Y
FRED CAIN-OOD	Y

NOTE: Final Patent Questionnaire sent to PDPI.

G-35-607

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629

June 19, 1987

Mr. James A. Dorst
Contracting Officer, M/S 126
NASA - Langley Research Center
Hampton, VA 23665-5225

Mr. Dorst:

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended May 31, 1987.

If you have questions or require additional information, please contact me at (404) 894-6759.

Sincerely,

Randall Bailey, Financial Mgmt Associate
Grants and Contracts Accounting

RB/djt

Enclosure

cc: Dr. C. S. Kiang, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
OCA/CSD 0420 (2 copies)
Contract Administrator, M/S 126
Technical Representative, M/S 475 (2 copies)
Cost Accounting, M/S 135 (via DCAA) (2 copies)
File: G-35-607/R6305-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 5/31/87 — 21

TO:
Langley Research Center
Attn: Mr. James A. Dorst
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM:
Georgia Tech Research Corporation
P. O. Box 100117
Atlanta, Georgia 30384

3. CONTRACT VALUE
a. COSTS: $ 70
b. FEE: $ - 0 -

4. FUND LIMITATION: $ 70 | $ - 0 -

5. BILLING
a. INVOICE AMTS BILLED: $ 22
b. TOTAL PYTS REC'D: $ - 0 -

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature): (
DATE: 06/19/87

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	DURING MONTH — PLANNED b.	CUM. TO DATE — ACTUAL c.	CUM. TO DATE — PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	DETAIL b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	11	11	11	11			20	31	31	
Fringe Benefits	2	2	2	2			3	5	5	
Overhead	9	9	9	9			18	27	27	
Other Direct Costs	0	0	0	0			7	7	7	
Total Costs	22	22	22	22			48	70	70	
G-35-607/R6305-0A0										

G-35-607

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629

July 24, 1987

Mr. James A. Dorst
Contracting Officer, M/S 126
NASA - Langley Research Center
Hampton, VA 23665-5225

Mr. Dorst:

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended June 30, 1987.

If you have questions or require additional information, please contact me at (404) 894-6759.

Sincerely,

Randall Bailey, Financial Mgmt Associate
Grants and Contracts Accounting

RB/djt

Enclosure

cc: Dr. C. S. Kiang, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Lucy Blunschi, Geophysical Sci. 0340
OCA/CSD 0420 (2 copies)
Contract Administrator, M/S 126
Technical Representative, M/S 475 (2 copies)
Cost Accounting, M/S 135 (via DCAA) (2 copies)
File: G-35-607/R6305-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 06/30/87 22

TO: Langley Research Center
Attn: Mr. James A. Dorst
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM: Georgia Tech Research Corporation
P. O. Box 100117
Atlanta, Georgia 30384

3. CONTRACT VALUE
a. COSTS $ 70
b. FEE $ - 0 -

4. FUND LIMITATION $ 70 $ - 0 -

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature) DATE 07/24/87

5. BILLING
a. INVOICE AMTS BILLED $ 39
b. TOTAL PYTS REC'D $ - 0 -

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	8.5	8.5	19.5	19.5			11.5	31	31	
Fringe Benefits	1.8	1.8	3.8	3.8			1.2	5	5	
Overhead	6.6	6.6	15.6	15.6			11.4	27	27	
Other Direct Costs	.1	.1	.1	.1			6.9	7	7	
Total Costs	17	17	39	39			31	70	70	

G-35-607/R6305-0A0

G-35-607

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629

August 25, 1987

Mr. James A. Dorst
Contracting Officer, M/S 126
NASA - Langley Research Center
Hampton, VA 23665-5225

Mr. Dorst:

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended July 31, 1987.

If you have questions or require additional information, please contact me at (404) 894-6759.

Sincerely,

Randall Bailey, Financial Mgmt Associate
Grants and Contracts Accounting

RB/djt

Enclosure

cc: Dr. C. S. Kiang, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Lucy Blunschi, Geophysical Sci. 0340
OCA/CSD 0420 (2 copies)
Contract Administrator, M/S 126
Technical Representative, M/S 475 (2 copies)
Cost Accounting, M/S 135 (via DCAA) (2 copies)
ONR RR 0490
File: G-35-607/R6305-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 07/31/87 23

TO:
Langley Research Center
Attn: Mr. James A. Dorst
Financial Management, M/S 126
Hampton, VA 23665 - 5225

FROM:
Georgia tech Research Corporation
P. O. Box 100117
Atlanta, Georgia 30384

3. CONTRACT VALUE
a. COSTS $ 70
b. FEE $ - 0 -

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature) — DATE: 08/25/87

4. FUND LIMITATION: $ 70 $ - 0 -

5. BILLING
a. INVOICE AMTS BILLED: $ 42.6
b. TOTAL PYTS REC'D: $ - 0 -

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	1.7	1.7	21.2	21.2			9.8	31	31	
Fringe Benefits	.6	.6	4.4	4.4			.6	5	5	
Overhead	.9	.9	16.5	16.5			10.5	27	27	
Other Direct Costs	.4	.4	.5	.5			6.5	7	7	
Total Costs	3.6	3.6	42.6	42.6			27.4	70	70	
G-35-607/R6305-0A0										

G-35-607

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629

February 12, 1988

Mr. James A. Dorst
Contracting Officer, M/S 126
NASA - Langley Research Center
Hampton, VA 23665-5225

Mr. Dorst:

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended August 31, 1987.

If you have questions or require additional information, please contact me at (404) 894-6757.

Sincerely,

Larry A. O'Connell, Accountant II
Grants and Contracts Accounting

LAC/djt

Enclosure

cc: Dr. C. S. Kiang, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Lucy Blunschi, Geophysical Sci. 0340
OCA/CSD 0420 (2 copies)
Contract Administrator, M/S 126
Technical Representative, M/S 475 (2 copies)
Cost Accounting, M/S 135 (via DCAA) (2 copies)
ONR RR 0490
File: G-35-607/R6305-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS
08/31/87 21

TO:
langley Research Center
Attn: Mr. James A. Dorst
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM:
Georgia Tech Research Corporation
P. O. Box 100117
Atlanta, Georgia 30384

3. CONTRACT VALUE
a. COSTS $ 70
b. FEE $ - 0 -

4. FUND LIMITATION
$ 70 $ - 0 -

DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1 - 18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 2-12-88

5. BILLING
a. INVOICE AMTS BILLED $ 46.3
b. TOTAL PYTS REC'D $ 42.6

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	1.9	1.9	23.1	23.1			7.9	31	31	
Fringe Benefits	.2	.2	4.6	4.6			.4	5	5	
Overhead	1.4	1.4	17.9	17.9			9.1	27	27	
Other Direct Costs	.3	.3	.7	.7			6.3	7	7	
Total Costs	3.8	3.8	46.3	46.3			23.7	70	70	
-35-607/R6305-0A0										

G-35-607

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629

February 12, 1988

Mr. James A. Dorst
Contracting Officer, M/S 126
NASA - Langley Research Center
Hampton, VA 23665-5225

Mr. Dorst:

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended September 30, 1987.

If you have questions or require additional information, please contact me at (404) 894-6757.

Sincerely,

Larry A. O'Connell, Accountant II
Grants and Contracts Accounting

LAC/djt

Enclosure

cc: Dr. C. S. Kiang, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Lucy Blunschi, Geophysical Sci. 0340
OCA/CSD 0420 (2 copies)
Contract Administrator, M/S 126
Technical Representative, M/S 475 (2 copies)
Cost Accounting, M/S 135 (via DCAA) (2 copies)
ONR RR 0490
File: G-35-607/R6305-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 09/30/87 — 22

TO: Langley Research Center
Attn: Mr. James A. Dorst
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM: Georgia Tech Research Corporation
P. O. Box 100117
Atlanta, Georgia 30384

3. CONTRACT VALUE
a. COSTS: $ 70
b. FEE: $ - 0 -

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature) — DATE: 2-12-88

4. FUND LIMITATION: $ 70 — $ - 0 -

5. BILLING
a. INVOICE AMTS BILLED: $ 50.3
b. TOTAL PYTS REC'D: $ 42.6

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	1	1	24.1	24.1			6.9	31	31	
Fringe Benefits	0	0	4.6	4.6			.4	5	5	
Overhead	1.5	1.5	19.4	19.4			7.6	27	27	
Other Direct costs	1.5	1.5	2.2	2.2			4.8	7	7	
Total Costs	4	4	50.3	50.3			19.7	70	70	
G-35-607/R6305-0A0										

G-35 607

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629

February 12, 1988

Mr. James A. Dorst
Contracting Officer, M/S 126
NASA - Langley Research Center
Hampton, VA 23665-5225

Mr. Dorst:

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended October 31, 1987.

If you have questions or require additional information, please contact me at (404) 894-6757.

Sincerely,

Larry A. Connell, Accountant II
Grants and Contracts Accounting

LAC/djt

Enclosure

cc: Dr. C. S. Kiang, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Lucy Blunschi, Geophysical Sci. 0340
OCA/CSD 0420 (2 copies)
Contract Administrator, M/S 126
Technical Representative, M/S 475 (2 copies)
Cost Accounting, M/S 135 (via DCAA) (2 copies)
ONR RR 0490
File: G-35-607/R6305-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS
10/31/87 22

TO:
Langley Research Center
Attn: Mr. James A. Dorst
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM:
Georgia Tech Research Corporation
P. O. Box 100117
Atlanta, Georgia 30384

3. CONTRACT VALUE
a. COSTS $ 70
b. FEE $ - 0 -

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature) DATE: 2-12-88

4. FUND LIMITATION
$ 70 $ - 0 -

5. BILLING
a. INVOICE AMTS BILLED $ 53.8
b. TOTAL PYTS REC'D $ 42.6

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	0	0	24.1	24.1			6.9	31	31	
Fringe Benefits	0	0	4.6	4.6			.4	5	5	
Overhead	1.3	1.3	20.7	20.7			6.3	27	27	
Other Direct costs	2.2	2.2	4.4	4.4			2.6	7	7	
Total Costs	3.5	3.5	53.8	53.8			16.2	70	70	
G-35-607/R6305-0A0										

G-35-607

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629

February 12, 1988

Mr. James A. Dorst
Contracting Officer, M/S 126
NASA - Langley Research Center
Hampton, VA 23665-5225

Mr. Dorst:

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended November 30, 1987.

If you have questions or require additional information, please contact me at (404) 894-6757.

Sincerely,

Larry A. Connell, Accountant II
Grants and Contracts Accounting

LAC/djt

Enclosure

cc: Dr. C. S. Kiang, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Lucy Blunschi, Geophysical Sci. 0340
OCA/CSD 0420 (2 copies)
Contract Administrator, M/S 126
Technical Representative, M/S 475 (2 copies)
Cost Accounting, M/S 135 (via DCAA) (2 copies)
ONR RR 0490
File: G-35-607/R6305-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS
11-30-87 21

TO:
Langley Research Center
Attn: Mr. James A. Dorst
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM:
Georgia Tech Research Corporation
P. O. Box 100117
Atlanta, Georgia 30384

3. CONTRACT VALUE
a. COSTS $ 70
b. FEE $ - 0 -

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 2-12-88

4. FUND LIMITATION
$ 70 $ - 0 -

5. BILLING
a. INVOICE AMTS BILLED $ 54.6
b. TOTAL PYTS REC'D $ 42.6

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	0	0	24.1	24.1			6.9	31	31	
Fringe Benefits	0	0	4.6	4.6			.4	5	5	
Overhead	.3	.3	21	21			6	27	27	
Other Direct Costs	.5	.5	4.9	4.9			2.1	7	7	
Total Costs	.8	.8	54.6	54.6			15.4	70	70	
:-35-607/R6305-0A0										

G-35-607

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629

February 12, 1988

Mr. James A. Dorst
Contracting Officer, M/S 126
NASA - Langley Research Center
Hampton, VA 23665-5225

Mr. Dorst:

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended December 31, 1987.

If you have questions or require additional information, please contact me at (404) 894-6757.

Sincerely,

Larry A. Connell, Accountant II
Grants and Contracts Accounting

LAC/djt

Enclosure

cc: Dr. C. S. Kiang, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Lucy Blunschi, Geophysical Sci. 0340
OCA/CSD 0420 (2 copies)
Contract Administrator, M/S 126
Technical Representative, M/S 475 (2 copies)
Cost Accounting, M/S 135 (via DCAA) (2 copies)
ONR RR 0490
File: G-35-607/R6305-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS
12/31/87 23

TO:
Langley Research Center
Attn: Mr. James A. Dorst
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM:
Georgia Tech Research Corporation
P. O. Box 100117
Atlanta, Georgia 30384

3. CONTRACT VALUE
a. COSTS $ 70
b. FEE $ - 0 -

4. FUND LIMITATION
$ 70 $ - 0 -

5. BILLING
a. INVOICE AMTS BILLED $ 59.2
b. TOTAL PYTS REC'D $ 42.6

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERSB/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 2-12-88

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED				8. ESTIMATED COSTS/HRS. TO COMPLETE			9. ESTIMATED FINAL COSTS/HOURS		10. UNFILLED ORDERS OUTSTANDING
	DURING MONTH		CUM. TO DATE		DETAIL					
	ACTUAL a.	PLANNED b.	ACTUAL c.	PLANNED d.	a.	b.	BALANCE OF CONTRACT c.	CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	
Direct Labor Dollars	2.9	2.9	27.0	27.0			4	31	31	
Fringe Benefits	0	0	4.6	4.6			.4	5	5	
Overhead	1.7	1.7	22.7	22.7			4.3	27	27	
Other Direct Costs	0	0	4.9	4.9			2.1	7	7	
Total Costs	4.6	4.6	59.2	59.2 ~~%(.@~~			10.8	70	70	
G-35-607/R6305-0A0										

G-35-607

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629

February 12, 1988

Mr. James A. Dorst
Contracting Officer, M/S 126
NASA - Langley Research Center
Hampton, VA 23665-5225

Mr. Dorst:

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended January 31, 1988.

If you have questions or require additional information, please contact me at (404) 894-6757.

Sincerely,

Larry A. Connell, Accountant II
Grants and Contracts Accounting

LAC/djt

Enclosure

cc: Dr. C. S. Kiang, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Lucy Blunschi, Geophysical Sci. 0340
OCA/CSD 0420 (2 copies)
Contract Administrator, M/S 126
Technical Representative, M/S 475 (2 copies)
Cost Accounting, M/S 135 (via DCAA) (2 copies)
ONR RR 0490
File: G-35-607/R6305-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

1. REPORT FOR MONTH ENDING AND NUMBER OPERATING DAYS: 01/31/88 21

TO:
Langley Research Center
Attn: Mr. James A. Dorst
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM:
Georgia Tech Research Corporation
P. O. Box 100117
Atlanta, Georgia 30384

3. CONTRACT VALUE
a. COSTS $ 70
b. FEE $ - 0 -

4. FUND LIMITATION
$ 70 $ - 0 -

5. BILLING
a. INVOICE AMTS BILLED $ 60.8
b. TOTAL PYTS REC'D $ 42.6

DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERSB/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 2-12-88

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	DURING MONTH — PLANNED b.	CUM. TO DATE — ACTUAL c.	CUM. TO DATE — PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	DETAIL b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	1.0	1.0	27.9	27.9			3.1	31	31	
Fringe Benefits	0	0	4.6	4.6			.4	5	5	
Overhead	.6	.6	23.3	23.3			3.7	27	27	
Other Direct Costs	0	0	4.9	4.9			2.1	7	7	
Total Costs	1.5	1.6	60.7	60.7			9.3	70	70	
G-35-607/R6305-0A0										

G-35-607

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624, 2629

July 5, 1988

Ms. Panice H. Clark, Contracting Officer
NASA - Langley Research Center
Financial Management Division M/S 126
Hampton, VA 23665

SUBJECT: NASA-Langley Contract NAS1-18487, Financial Management Report

Ms. Clark:

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended February 28, 1988. I apologize for the delay in submitting this report.

If you have questions or require additional information, please contact Larry Connell at (404) 894-6757 or Linda Gill at (404) 894-5526.

Sincerely,

David V. Welch, Director
Grants and Contracts Accounting

DVW/LAC/djt

Enclosure

cc: Dr. C. S. Kiang, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Luci Blunschi, Geophysical Sci. 0340
Ms. Ina Lashley, OCA 0420
OCA/CSD 0420 (2 copies)
Tech. Rep. M/S 234
Cost Accounting M/S 135 via (M/S 175) via (DCAA)
ONR RR 0490
File: G-35-~~691~~ 607/R6271-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS
2/28/88 21

Langley Research Center
Attn: Ms. Panice H. Clark
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM:
Georgia Tech Ressearch Corp.
P. O. Box 100117
Atlanta, GA 30384

3. CONTRACT VALUE
a. COSTS $ 70
b. FEE $ - 0 -

4. FUND LIMITATION
$ 70 $ - 0 -

5. BILLING
a. INVOICE AMTS BILLED $ 60.8
b. TOTAL PYTS REC'D $ 60.8

DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERSB/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 07/05/88

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	1.0	1.0	28.9	28.9			2.1	31	31	
Fringe Benefits	0	0	4.6	4.6			.4	5	5	
Overhead	1.0	1.0	24.3	24.3			2.7	27	27	
Other Direct Costs	.7	.7	5.6	5.6			1.4	7	7	
Total Costs	2.7	2.7	63.40	63.40			6.6	70	70	

-35-607/R6305-0A0

6-35-607

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629

July 5, 1988

Ms. Panice H. Clark, Contracting Officer
NASA - Langley Research Center
Financial Management Division M/S 126
Hampton, VA 23665

SUBJECT: NASA-Langley Contract NAS1-18487, Financial Management Report

Ms. Clark:

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended March 31, 1988. I apologize for the delay in submitting this report.

If you have questions or require additional information, please contact Larry Connell at (404) 894-6757 or Linda Gill at (404) 894-5526.

Sincerely,

David V. Welch, Director
Grants and Contracts Accounting

DVW/LAC/djt

Enclosure

cc: Dr. C. S. Kiang, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Luci Blunschi, Geophysical Sci. 0340
Ms. Ina Lashley, OCA 0420
OCA/CSD 0420 (2 copies)
Tech. Rep. M/S 234
Cost Accounting M/S 135 via (M/S 175) via (DCAA)
ONR RR 0490
File: G-35-~~691~~ 607/R6271-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS
03/31/88 23

TO: Langley Research Center
Attn: Ms. Panice H. Clark
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM: Georgia Tech Research Corp.
P. O. Box 100117
Atlanta, GA 30384

3. CONTRACT VALUE
a. COSTS $ 70
b. FEE $ - 0 -

4. FUND LIMITATION
$ 70 $ - 0 -

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERSB/SAGE II
d. AUTH. CONTR. REP. (Signature) DATE: 07/05/88

5. BILLING
a. INVOICE AMTS BILLED $ 60.8
b. TOTAL PYTS REC'D $ 60.8

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	DURING MONTH — PLANNED b.	CUM. TO DATE — ACTUAL c.	CUM. TO DATE — PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	DETAIL b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	1.0	1.0	29.9	29.9			1.1	31	31	
Fringe Benefits	0	0	4.6	4.6			.4	5	5	
Overhead	.6	.6	24.9	24.9			2.1	27	27	
Other Direct Costs	0	0	5.6	5.6			1.4	7	7	
Total Costs	1.6	1.6	65.0	65.0			5.0	70	70	
G-35-607/R6305-0A0										

TO: PAT HETTMULLER 35-607
8/19/88

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629

August 16, 1988

Ms. Panice H. Clark, Contracting Officer
NASA - Langley Research Center
Financial Management Division M/S 126
Hampton, VA 23665

SUBJECT: NASA-Langley Contract NAS1-18487, Financial Management Report

Ms. Clark:

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended July 31, 1988.

If you have questions or require additional information, please contact Larry Connell at (404) 894-6757.

Sincerely,

David V. Welch, Director
Grants and Contracts Accounting

DVW/LAC/djt

Enclosure

cc: Dr. C. S. Kiang, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Luci Blunschi, Geophysical Sci. 0340
Ms. Ina Lashley, OCA 0420
OCA/CSD 0420 (2 copies)
Tech. Rep. M/S 234
Cost Accounting M/S 135 via (M/S 175) via (DCAA)
ONR RR 0490
File: G-35-~~691~~ 607/R6271-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 07/31/88 21

TO: Langley Research Center
Attn: Ms. Panice H. Clark
Financial Management, M/S 126
Hampton, VA. 23665-5225

FROM: Georgia Tech Research Corp.
P.O. Box 1-0117
Atlanta, GA. 30384.

3. CONTRACT VALUE
a. COSTS $70
b. FEE $ -0-

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERSB/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 08/16/88

4. FUND LIMITATION
$70 $ -0-

5. BILLING
a. INVOICE AMTS BILLED $90.6
b. TOTAL PYTS REC'D $ 60.3

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	.4	.4	42.1	42.1			15.9	58	58	
Fringe Benefits	-0-	-0-	7.0	7.0			2.5	9.5	9.5	
Overhead	.2	.2	34.5	34.5			15.2	49.7	49.7	
Other Direct Costs	-0-	-0-	7.0	7.0			5.7	12.7	12.7	
Total Costs	.6	.6	90.6	90.6			39.3	129.9	129.9	
G-35-607/R6305-0A0										

G-35-607

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629

September 27, 1988

Ms. Panice H. Clark, Contracting Officer
NASA - Langley Research Center
Financial Management Division M/S 126
Hampton, VA 23665

SUBJECT: NASA-Langley Contract NAS1-18487, Financial Management Report

Dear Ms. Clark:

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended August 31, 1988.

If you have questions or require additional information, please contact Larry Connell at (404) 894-6757.

Sincerely,

David V. Welch, Director
Grants and Contracts Accounting

DVW/LAC/djt

Enclosure

cc: Dr. C. S. Kiang, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Luci Blunschi, Geophysical Sci. 0340
Ms. Ina Lashley, OCA 0420
OCA/CSD 0420 (2 copies)
Tech. Rep. M/S 234
Cost Accounting M/S 135 via (M/S 175) via (DCAA)
ONR RR 0490
File: G-35-607/R6305-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS: 08/31/88 23

TO: Langley Research Center
Attn: Ms. Panice H. Clark
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM: Georgia Tech Research Corp.
P. O. Box 100117
Atlanta, GA. 30384

3. CONTRACT VALUE
a. COSTS: $ 130
b. FEE: $ -0-

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERSB/SAGE II
d. AUTH. CONTR. REP. (Signature):
DATE: 09/28/88

4. FUND LIMITATION: $ 130 $ -0-

5. BILLING
a. INVOICE AMTS BILLED: $ 95.2
b. TOTAL PYTS REC'D: $ 90.0

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	7. DURING MONTH — PLANNED b.	7. CUM. TO DATE — ACTUAL c.	7. CUM. TO DATE — PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	8. DETAIL b.	8. BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	9. CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	.8	.8	42.8	42.8			15.2	58	58	
Fringe Benefits	-0-	-0-	7.1	7.1			2.4	9.5	9.5	
Overhead	1.7	1.7	36.2	36.2			13.5	49.7	49.7	
Other Direct Costs	2.0	2.0	9.0	9.0			3.7	12.7	12.7	
Total Costs	4.5	4.5	95.1	95.1			34.8	129.9	129.9	

G-35-607

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629

February 22, 1989

Ms. Panice H. Clark, Contracting Officer
NASA - Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

SUBJECT: NASA-Langley Contract NAS1-18487
Financial Management Report (533M)

Dear Ms. Clark:

Enclosed are the Monthly Contractor Financial Management Reports for Contract No. NAS1-18487 for the months ending September, 1988 through January, 1989.

If you have questions or require additional information, please contact either Linda Krantz at (404) 894-5525 or Linda Gill at (404) 894-5526.

Sincerely,

David V. Welch
Director

DVW/LAG/djt

Enclosures

cc: Dr. W. L. Chameides, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Luci Blunschi, Geophysical Sci. 0340
Ms. Ina Lashley, OCA/PAD 0420
OCA/CSD 0420 (2 copies)
Tech. Rep. M/S 234
Cost Accounting M/S 135 via (M/S 175) via (DCAA)
ONR RR 0490
File: G-35-607/24-6-R6305-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS: 01/31/89 20

TO: Langley Research Center
Attn: Ms. Panice H. Clark
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM: Georgia Tech Research Corp.
P. O. Box 100117
Atlanta, GA 30384

3. CONTRACT VALUE
a. COSTS $ 130
b. FEE $ - 0 -

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERSB/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 2-22-89

4. FUND LIMITATION: $ 130 $ - 0 -

5. BILLING
a. INVOICE AMTS BILLED: $ 113.5
b. TOTAL PYTS REC'D: $90.0

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED: DURING MONTH: ACTUAL a.	PLANNED b.	CUM. TO DATE: ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE: DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS: CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	0	0	51.7	51.7			6.3	58	58	
Fringe Benefits	0	0	8.6	8.6			1.0	9.6	9.6	
Overhead	0	0	43.1	43.1			6.6	49.7	49.7	
Other Direct Costs	0	0	10.1	10.1			2.6	12.7	12.7	
Total Costs	0	0	113.5	113.5			16.5	130.0	130.0	

G-35-607/R6305-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS
12/31/88 17

TO:
Langley Research Center
Attn: Ms. Panice H. Clark
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM:
Georgia Tech Research Corp.
P. O. Box 110117
Atlanta, GA 30384

3. CONTRACT VALUE
a. COSTS $ 130
b. FEE $ - 0 -

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERSB/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 2-22-89

4. FUND LIMITATION
$ 130 $ - 0 -

5. BILLING
a. INVOICE AMTS BILLED $ 113.5
b. TOTAL PYTS REC'D $ 90.0

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED: DURING MONTH: ACTUAL a.	PLANNED b.	CUM. TO DATE: ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE: DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS: CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	0	0	51.7	51.7			6.3	58	58	
Fringe Benefits	0	0	8.6	8.6			1.0	9.6	9.6	
Overhead	0	0	43.1	43.1			6.6	49.7	49.7	
Other Direct Costs	0	0	10.1	10.1			2.6	12.7	12.7	
Total	0	0	113.5	113.5			16.5	130.0	130.0	
C-35-607/R6305-0A0										

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH / OPERATING DAYS: 11/30/88 . 20

TO:
Langley Research Center
Attn: Ms. Panice H. Clark
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM:
Georgia Tech Research Corp.
P. O. Box 100117
Atlanta, GA 30384

3. CONTRACT VALUE
a. COSTS $ 130
b. FEE $ - 0 -

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERSB/SAGE II
d. AUTH. CONTR. REP. (Signature) / DATE: 2-22-89

4. FUND LIMITATION: $ 130 $ - 0 -

5. BILLING
a. INVOICE AMTS BILLED: $ 113.5
b. TOTAL PYTS REC'D: $ 90.0

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	0	0	51.7	51.7			6.3	58	58	
Fringe Benefits	0	0	8.6	8.6			1.0	9.6	9.6	
Overhead	.7	.7	43.1	43.1			6.6	49.7	49.7	
Other Direct Costs	1.1	1.1	10.1	10.1			2.6	12.7	12.7	
Total Costs	1.8	1.8	113.5	113.5			16.5	130.0	130.0	
G-35-607/R6305-0A0										

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS
10/31/88 21

TO:
Langley Research Center
Attn: Ms. Panice H. Clark
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM:
Georgia Tech Research Corp.
P. O. Box 100117
Atlanta, GA 30384

3. CONTRACT VALUE
a. COSTS $ 130
b. FEE $ 0

4. FUND LIMITATION
$ 130 $ 0

5. BILLING
a. INVOICE AMTS BILLED $ 111.7
b. TOTAL PYTS REC'D $ 90.0

1. DESCRIPTION OF CONTRACT

a. TYPE
Cost Reimbursable

b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.
NAS1-18487

c. SCOPE OF WORK
ERSB/SAGE II

d. AUTH. CONTR. REP. (Signature)

DATE
2-22-89

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED				8. ESTIMATED COSTS/HRS. TO COMPLETE			9. ESTIMATED FINAL COSTS/HOURS		10. UNFILLED ORDERS OUTSTANDING
	DURING MONTH		CUM. TO DATE		DETAIL		BALANCE OF CONTRACT	CONTRACTOR ESTIMATE	CONTRACT VALUE	
	ACTUAL a.	PLANNED b.	ACTUAL c.	PLANNED d.	a.	b.	c.	a.	b.	
Direct Labor Dollars	7.0	7.0	51.7	51.7			6.3	58	58	
Fringe Benefits	1.5	1.5	8.6	8.6			1.0	9.6	9.6	
Overhead	5.0	5.0	42.4	42.4			7.3	49.7	49.7	
Other Direct Costs	0	0	9.0	9.0			3.7	12.7	12.7	
Total Costs	13.5	13.5	111.7	111.7			18.3	130.0	130.0	
G-35-607/R6305-0A0										

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH & OPERATING DAYS: 09/30/88 21

TO:
Langley Research Center
Attn: Ms. Panice H. Clark
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM:
Georgia Tech Research Corp.
P. O. Box 100117
Atlanta, GA 30384

3. CONTRACT VALUE: a. COSTS $ 130; b. FEE $ 0

4. FUND LIMITATION: $ 130; $ 0

5. BILLING: a. INVOICE AMTS BILLED $ 98.2; b. TOTAL PYTS REC'D $ 90.0

1. DESCRIPTION OF CONTRACT

a. TYPE: Cost Reimbursable

b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487

c. SCOPE OF WORK: ERSB/SAGE II

d. AUTH. CONTR. REP. (Signature) DATE: 2-22-89

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	1.9	1.9	44.7	44.7			13.3	58	58	
Fringe Benefits	0	0	7.1	7.1			2.5	9.6	9.6	
Overhead	1.2	1.2	37.4	37.4			12.3	49.7	49.7	
Other Direct Costs	0	0	9.0	9.0			3.7	12.7	12.7	
Total Costs	3.1	3.1	98.2	98.2			31.8	130.0	130.0	
G-35-607/R6305-0A0										

G-35-607

Georgia Tech

Office of Grants and Contract Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
(404) 894-5519 Fax

March 14, 1989

Ms. Panice H. Clark, Contracting Officer
NASA - Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

SUBJECT: NASA-Langley Contract NAS1-18487 Financial Management Report

Dear Ms. Clark:

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended February 28, 1989.

If you have questions or require additional information, please contact Linda Krantz at (404) 894-5525.

Sincerely,

David V. Welch
Director

DVW/LMK/djt

Enclosures

cc: Dr. W. L. Chameides, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Luci Blunschi, Geophysical Sci. 0340
Ms. Ina Lashley, OCA/PAD 0420
OCA/CSD 0420 (2 copies)
Tech. Rep. M/S 234
Cost Accounting M/S 135 via (M/S 175) via (DCAA)
ONR RR 0490
File: G-35-607/R6305-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 02/28/89 — 20

TO: Langley Research Center
Attn: Ms. Panice H. Clark
Financial Management, M/S 126
Hampton, VA 23665-5225

FROM: Georgia Tech Research Corp.
P. O. Box 100117
Atlanta, GA 30384

3. CONTRACT VALUE
a. COSTS: $ 130
b. FEE: $ - 0 -

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERSB/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 3-14-89

4. FUND LIMITATION: $ 130 — $ - 0 -

5. BILLING
a. INVOICE AMTS BILLED: $ 114.6
b. TOTAL PYTS REC'D: $ 95.2

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED				8. ESTIMATED COSTS/HRS. TO COMPLETE			9. ESTIMATED FINAL COSTS/HOURS		10. UNFILLED ORDERS OUTSTANDING
	DURING MONTH		CUM. TO DATE		DETAIL		BALANCE OF CONTRACT			
	ACTUAL a.	PLANNED b.	ACTUAL c.	PLANNED d.	a.	b.	c.	CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	
Direct Labor Dollars	0	0	51.7	51.7			6.3	58	58	
Fringe Benefits	0	0	8.6	8.6			1.0	9.6	9.6	
Overhead	0	0	43.5	43.5			6.2	49.7	49.7	
Other Direct Costs	0	0	10.8	10.8			1.9	12.7	12.7	
Total Costs	0	0	114.6	114.6			15.4	130.0	130.0	

G-35-607/R6305-0A0

G-35-607

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

May 11, 1989

Mr. George Maddrea, Contracting Officer
NASA - Langley Research Center
Financial Management Division
M/S 475
Hampton, VA 23665

SUBJECT: NASA-Langley Contract NAS1-18487 Financial Management Report

Dear Mr. Maddrea,

Enclosed is the Monthly Contractor Financial Management Report for Contract No. NAS1-18487 for the period ended April 30, 1989.

If you have questions or require additional information, please contact Linda Krantz at (404) 894-5525.

Sincerely,

David V. Welch
Director

DVW/LMK/djt

Enclosures

cc: Dr. W. L. Chameides, Geophysical Sci. 0340
Dr. D. M. Cunnold, Geophysical Sci. 0340
Ms. Luci Blunschi, Geophysical Sci. 0340
Ms. Ina Lashley, OCA/PAD 0420
OCA/CSD 0420 (2 copies)
Tech. Rep. M/S 234
Cost Accounting M/S 135 via (M/S 175) via (DCAA)
ONR RR 0490
File: G-35-607/R6305-0A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS
04/30/89 20

TO:
Langley Research Center
Attn: Mr. George Maaarea
Financial Management, M/S 475
Hampton, VA 23665-5225

FROM:
Georgia Tech Research Corp.
P. O. Box 100117
Hampton, VA 30384

3. CONTRACT VALUE
a. COSTS $ 192
b. FEE $ -0-

4. FUND LIMITATION
$ 192
$ -0-

1. DESCRIPTION OF CONTRACT
a. TYPE: Cost Reimbursable
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERSB/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 05-11-89

5. BILLING
a. INVOICE AMTS BILLED $ 133.7
b. TOTAL PYTS REC'D $ 113.5

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	9.2	9.2	60.9	60.9			21.1	82.0	82.0	
Fringe Benefits	2.3	2.3	11.0	11.0			2.4	13.4	13.4	
Overhead	7.2	7.2	50.7	50.7			22.4	73.1	73.1	
Other Direct Costs	.4	.4	11.1	11.1			12.5	23.6	23.6	
Total Costs	19.1	19.1	133.7	133.7			58.4	192.1	192.1	
G-35-607/R6305-0A0										

Georgia Tech

G-35-607

Mary Wolfe

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

December 4, 1989

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period ended October 31, 1989.

If you have any questions, or if we can be of further assistance, please call either Ellen Scott at (404) 894-6759, or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ers

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies)
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 10/31/89 — 22

TO: LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT, M/S 126
HAMPTON, VA 23665-5225

FROM: GEORGIA TECH RESEARCH CORPORATION
P. O. BOX 100117
ATLANTA, GA 30384

3. CONTRACT VALUE
a. COSTS: $ 192.1
b. FEE: $ -0-

1. DESCRIPTION OF CONTRACT
a. TYPE: COST REIMBURSABLE
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature) — DATE: 12-04-89

4. FUND LIMITATION: $ 192.1 — $ -0-

5. BILLING
a. INVOICE AMTS BILLED: $ 167.6
b. TOTAL PYTS REC'D: $ 166.7

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED				8. ESTIMATED COSTS/HRS. TO COMPLETE			9. ESTIMATED FINAL COSTS/HOURS		10. UNFILLED ORDERS OUTSTANDING
	DURING MONTH		CUM. TO DATE		DETAIL					
	ACTUAL a.	PLANNED b.	ACTUAL c.	PLANNED d.	a.	b.	BALANCE OF CONTRACT c.	CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	
Direct Labor Dollars	-0-	-0-	77.0	77.0			5.0	82.0	82.0	
Fringe Benefits	-0-	-0-	15.0	15.0			(1.6)	13.4	13.4	
Overhead	-0-	-0-	63.4	63.4			9.7	73.1	73.1	
Other Direct Costs	-0-	-0-	12.2	12.2			11.4	23.6	23.6	
TOTAL COSTS	-0-	-0-	167.6	167.6			24.5	192.1	192.1	

Questions pertaining to this report should be directed to:
Ellen Scott (404) 894-6759

G-35-607/R6305-0A0

Mary Wolfe G-35-607

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Lyman Hall/Emerson Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

January 16, 1990

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period ended December 31, 1989.

If you have any questions, or if we can be of further assistance, please call either Ellen Scott at (404) 894-6759, or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ers

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies)
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS
12/31/89 16

TO:
LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT, M/S 126
HAMPTON, VA 23665-5225

FROM:
GEORGIA TECH RESEARCH CORPORATION
P. O. BOX 100117
ATLANTA, GA 30384

3. CONTRACT VALUE
a. COSTS $ 192.1
b. FEE $ -0-

1. DESCRIPTION OF CONTRACT
a. TYPE: COST REIMBURSABLE
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 01/16/90

4. FUND LIMITATION
$ 192.1 $ -0-

5. BILLING
a. INVOICE AMTS BILLED: $ 180.1
b. TOTAL PYTS REC'D: $ 167.6

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED				8. ESTIMATED COSTS/HRS. TO COMPLETE			9. ESTIMATED FINAL COSTS/HOURS		10. UNFILLED ORDERS OUTSTANDING
	DURING MONTH		CUM. TO DATE		DETAIL		BALANCE OF CONTRACT			
	ACTUAL a.	PLANNED b.	ACTUAL c.	PLANNED d.	a.	b.	c.	CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	
Direct Labor Dollars	1.5	1.5	81.9	81.9			.1	82.0	82.0	
Fringe Benefits	.4	.4	15.5	15.5			(2.1)	13.4	13.4	
Overhead	1.2	1.2	68.2	68.2			4.9	73.1	73.1	
Other Direct Costs	0	0	14.5	14.5			9.1	23.6	23.6	
TOTAL COSTS	3.1	3.1	180.1	180.1			12.0	192.1	192.1	

Questions pertaining to this report should be directed to:

Ellen Scott (404) 894-6759

G-35-607/R6305-0A0

G-35-607

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

May 14, 1990

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period ended April 30, 1990.

If you have any questions, or if we can be of further assistance, please call either Ellen Scott at (404) 894-6759, or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ers

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies)
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Budget Bureau No. 104-R0011

04/30/90 21

TO: LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT, M/S 126
HAMPTON, VA 23665-5225

FROM: GEORGIA TECH RESEARCH CORPORATION
P. O. BOX 100117
ATLANTA, GA 30384

3. CONTRACT VALUE — a. COSTS: $ 192.1 — b. FEE: $ -0-

4. FUND LIMITATION: $ 192.1 — $ -0-

5. BILLING — a. INVOICE AMTS BILLED: $ 186.5 — b. TOTAL PYTS REC'D: $ 180.1

1. DESCRIPTION OF CONTRACT

a. TYPE: COST REIMBURSABLE

b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS2-18487

c. SCOPE OF WORK: ERBS/SAGE II

d. AUTH. CONTR. REP. (Signature) — DATE: 05/14/90

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	.1	.1	83.9	83.9			(1.9)	82.0	82.0	
Fringe Benefits	0	0	15.9	15.9			(2.5)	13.4	13.4	
Overhead	.1	.1	70.7	70.7			2.4	73.1	73.1	
Other Direct Costs	0	0	16.0	16.0			7.6	23.6	23.6	
Total Costs	.2	.2	186.5	186.5			5.6	192.1	192.1	

Questions pertaining to this report should be directed to:

Ellen Scott (404) 894-6759

G-35-607/R6305-0A0

G-35-607

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

September 18, 1990

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period ended August 31, 1990.

If you have any questions or if we can be of further assistance, please call either Tammy Putnal at (404) 894-6757 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies)
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS
08/31/90 23

TO: LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT, M/S 126
HAMPTON, VA 23665-5225

FROM: GEORGIA TECH RESEARCH CORPORATION
P. O. BOX 100117
ATLANTA, GEORGIA 30384

3. CONTRACT VALUE
a. COSTS $ 370.3
b. FEE $ -0-

1. DESCRIPTION OF CONTRACT
a. TYPE: COST REIMBURSABLE
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS2-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 09-17-90

4. FUND LIMITATION
$ 251.5 $ -0-

5. BILLING
a. INVOICE AMTS BILLED $ 233
b. TOTAL PYTS REC'D $ 186.5

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	DURING MONTH — PLANNED b.	CUM. TO DATE — ACTUAL c.	CUM. TO DATE — PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	DETAIL b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	1.7	1.7	105.2	105.2			5.3	110.5	110.5	
Fringe Benefits	.1	.1	21.1	21.1			(.2)	20.9	20.9	
Overhead	1.2	1.2	88.5	88.5			7.2	95.7	95.7	
Other Direct Costs	.2	.2	18.1	18.1			6.3	24.4	24.4	
Total Costs	3.2	3.2	232.9	232.9			18.6	251.5		
G-35-607/R6305-0A0										

Questions pertaining to this report should be directed to: Ms. Tammy Putnal
(404) 894-6757

Georgia Tech

Office of Grants and Contracts Accounting
Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

January 10, 1990

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended December 31, 1990.

If you have any questions or if we can be of further assistance, please call either Tammy Putnal at (404) 894-6757 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies)
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

12/31/90 20

NASA - LANGLEY RESEARCH CENTER ATTN: MS. SANDRA MURACA FINANCIAL MANAGEMENT, M/S 126 HAMPTON, VA 23665-5225	FROM: GEORGIA TECH RESEARCH CORPORATION P. O. BOX 100117 ATLANTA, GA 30384

3. CONTRACT VALUE: a. COSTS $ 370.3; b. FEE $ -0-

4. FUND LIMITATION: $ 251.5 $ -0-

DESCRIPTION OF CONTRACT: a. TYPE: COST REIMBURSABLE; b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS2-18487; c. SCOPE OF WORK: ERBS/SAGE II; d. AUTH. CONTR. REP. (Signature); DATE: 01/10/91

5. BILLING: a. INVOICE AMTS BILLED $ 241; b. TOTAL PYTS REC'D $ 238.5

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
DIRECT LABOR DOLLARS	.7	.7	109.9	109.9			.6	110.5	110.5	
FRINGE BENEFITS	0	0	21.1	21.1			(.2)	20.9	20.9	
OVERHEAD	.5	.5	91.7	91.7			4.0	95.7	95.7	
OTHER DIRECT COSTS	.1	.1	18.3	18.3			6.1	24.4	24.4	
TOTAL COSTS	1.3	1.3	241	241			10.5	251.5	251.5	
35-607/R6305-0A0										

Questions pertaining to this report should be directed to:

Ms. Tammy Putnal (404) 894-6757

Georgia Tech

G-35-607

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

Mary Wolfe

February 6, 1991

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended January 31, 1991.

If you have any questions or if we can be of further assistance, please call either Tammy Putnal at (404) 894-6757 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies)
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS
01/31/91 21

NASA - LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT, M/S 126
HAMPTON, VA 23665-5225

FROM:
GEORGIA TECH RESEARCH CORPORATION
P. O. BOX 100117
ATLANTA, GA 30384

3. CONTRACT VALUE
a. COSTS $ 370.3
b. FEE $-0-

DESCRIPTION OF CONTRACT
a. TYPE: COST REIMBURSABLE
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS2-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 02/07/91

4. FUND LIMITATION
$ 251.5 $-0-

5. BILLING
a. INVOICE AMTS BILLED: $ 242.6
b. TOTAL PYTS REC'D: $ 238.5

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
DIRECT LABOR DOLLARS	0	0	109.9	109.9			.6	110.5	110.5	
FRINGE BENEFITS	0	0	21.1	21.1			(.2)	20.9	20.9	
OVERHEAD	.6	.6	92.3	92.3			3.4	95.7	95.7	
OTHER DIRECT COSTS	1.0	1.0	19.3	19.3			5.1	24.4	24.4	
TOTAL COSTS	1.6	1.6	242.6	242.6			8.9	251.5	251.5	

Questions pertaining to this report should be directed to:

Ms. Tammy Putnal (404) 894-6757

G-35-607/R6305-0A0

G-35-607

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

May 16, 1991

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended April 30, 1991.

If you have any questions or if we can be of further assistance, please call either Tammy Putnal at (404) 894-6757 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies)
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Budget Bureau No. 104-R0011

04/30/91 22

NASA - LANGLEY RESEARCH CENTER ATTN: MS. SANDRA MURACA FINANCIAL MANAGEMENT, M/S 126 HAMPTON, VA 23665-5225	FROM: GEORGIA TECH RESEARCH CORPORATION P. O. BOX 100117 ATLANTA, GA 30384	3. CONTRACT VALUE a. COSTS $ 370.3	b. FEE $ -0-
DESCRIPTION OF CONTRACT — a. TYPE: COST REIMBURSABLE	b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS2-18487	4. FUND LIMITATION $ 251.5	$ -0-
c. SCOPE OF WORK: ERBS/SAGE II	d. AUTH. CONTR. REP. (Signature) — DATE 05/17/91	5. BILLING a. INVOICE AMTS BILLED $ 249.1	b. TOTAL PYTS REC'D $ 242.6

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
DIRECT LABOR DOLLARS	0	0	115.4	115.4			(4.9)	110.5	110.5	
FRINGE BENEFITS	0	0	21.2	21.2			(.3)	20.9	20.9	
OVERHEAD	0	0	96.1	96.1			(.4)	95.7	95.7	
OTHER DIRECT COSTS	0	0	19.8	19.8			4.6	24.4	24.4	
TOTAL COSTS	0	0	252.5	252.5			(1.0)	251.5	251.5	

Questions pertaining to this report should be directed to:

Ms. Tammy Putnal
(404) 894-6757

G-35-607/R6305-0A0

G-35-607 ~~File~~ M. WOLFE

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

June 5, 1991

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended May 31, 1991.

If you have any questions or if we can be of further assistance, please call either Tammy Putnal at (404) 894-6757 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies)
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved Budget Bureau No. 104-R0011

05/31/91 23

NASA - LANGLEY RESEARCH CENTER ATTN: MS. SANDRA MURACA FINANCIAL MANAGEMENT, M/S 126 HAMPTON, VA 23665-5225	FROM: GEORGIA TECH RESEARCH CORPORATION P. O. BOX 100117 ATLANTA, GA 30384	3. CONTRACT VALUE a. COSTS $ 370.3 b. FEE $ -0-
DESCRIPTION OF CONTRACT a. TYPE: COST REIMBURSABLE	b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO. NAS2-18487	4. FUND LIMITATION $ 251.5 $ -0-
c. SCOPE OF WORK: ERBS/SAGE II	d. AUTH. CONTR. REP. (Signature) DATE 06/06/91	5. BILLING a. INVOICE AMTS BILLED $ 249.1 b. TOTAL PYTS REC'D $ 249.1

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	DURING MONTH — PLANNED b.	CUM. TO DATE — ACTUAL c.	CUM. TO DATE — PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	DETAIL b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
DIRECT LABOR DOLLARS	3.3	3.3	118.7	118.7			(8.2)	110.5	110.5	
FRINGE BENEFITS	.9	.9	22.1	22.1			(1.2)	20.9	20.9	
OVERHEAD	2.7	2.7	98.8	98.8			(3.1)	95.7	95.7	
OTHER DIRECT COSTS	0	0	19.8	19.8			4.6	24.4	24.4	
TOTAL COSTS	6.9	6.9	259.4	259.4			(7.9)	251.5	251.5	

Questions pertaining to this report should be directed to: Ms. Tammy Putnal (404) 894-6757

-35-607/R6305-0A0

G-35-607

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

August 8, 1991

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended July 31, 1991.

If you have any questions or if we can be of further assistance, please call either Tammy Putnal at (404) 894-6757 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies)
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS
07/30/91 22

LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT, M/S 126
HAMPTON, VA 23665-5225

FROM:
GEORGIA TECH RESEARCH CORPORATION
P. O. BOX 100117
ATLANTA, GA 30384

3. CONTRACT VALUE
a. COSTS $ 370.3
b. FEE $ -0-

4. FUND LIMITATION
$ 311.5 $ -0-

5. BILLING
a. INVOICE AMTS BILLED $ 260.9
b. TOTAL PYTS REC'D $ 249.1

DESCRIPTION OF CONTRACT
a. TYPE: COST REIMBURSABLE
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS2-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 08/08/91

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED: DURING MONTH: ACTUAL a.	PLANNED b.	CUM. TO DATE: ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE: DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS: CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
DIRECT LABOR DOLLARS	.8	.8	119.5	119.5			18.6	138.1	138.1	
FRINGE BENEFITS	.1	.1	22.2	22.2			2.8	25.0	25.0	
OVERHEAD	.6	.6	99.4	99.4			19.4	118.8	118.8	
OTHER DIRECT COSTS	0	0	19.8	19.8			9.8	29.6	29.6	
TOTAL COSTS	1.5	1.5	260.9	260.9			50.6	311.5	311.5	
G-35-607/R6305-0A0										

Questions pertianing to this report should be directed to: Ms. Tammy Putnal (404) 894-6757

G-35-607

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

September 11, 1991

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended August 31, 1991.

If you have any questions or if we can be of further assistance, please call either Tammy Putnal at (404) 894-6757 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies)
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS
08/31/91 22

TO: LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT, M/S 126
HAMPTON, VA 23665-5225

FROM:
GEORGIA TECH RESEARCH CORPORATION
P. O. BOX 100117
ATLANTA, GA 30384

3. CONTRACT VALUE
a. COSTS $ 370.3
b. FEE $ -0-

4. FUND LIMITATION
$ 311.5 $ -0-

5. BILLING
a. INVOICE AMTS BILLED $ 266.0
b. TOTAL PYTS REC'D $ 249.1

DESCRIPTION OF CONTRACT

a. TYPE: COST REIMBURSABLE

b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS2-18487

c. SCOPE OF WORK: ERBS/SAGE II

d. AUTH. CONTR. REP. (Signature)

DATE: 09-11-91

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
DIRECT LABOR DOLLARS	1.1	1.1	120.6	120.6			17.5	138.1	138.1	
FRINGE BENEFITS	0	0	22.2	22.2			2.8	25.0	25.0	
OVERHEAD	1.9	1.9	101.3	101.3			17.5	118.8	118.8	
OTHER DIRECT COSTS	2.1	2.1	21.9	21.9			7.7	29.6	29.6	
TOTAL COSTS	5.1	5.1	266	266			45.5	311.5	311.5	

Questions pertaining to this report should be directed to:

Ms. Tammy Putnal (404) 894-6757

G-35-607/R6305-0A0

G-35-607

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

November 20, 1991

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
Mail Stop 126
Hampton, VA 23665-5225

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca,

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended October 31, 1991.

If you have any questions or if we can be of further assistance, please call either Tammy Putnal at (404) 894-6757 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/djt

Enclosure

c: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies) ✓-1 mw
Don Calder, ONR RR, 0490
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
File: G-35-607/R6305-0A0

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

10/31/91 23

TO: LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT, M/S 126
HAMPTON, VA 23665-5225

FROM: GEORGIA TECH RESEARCH CORPORATION
P. O. BOX 100117
ATLANTA, GA 30384

3. CONTRACT VALUE
a. COSTS $ 370.3
b. FEE $ -0-

1. DESCRIPTION OF CONTRACT
a. TYPE: COST REIMBURSABLE
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS2-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 11/20/91

4. FUND LIMITATION
$ 311.5 $ -0-

5. BILLING
a. INVOICE AMTS BILLED $ 270
b. TOTAL PYTS REC'D $ 249.1

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED				8. ESTIMATED COSTS/HRS. TO COMPLETE			9. ESTIMATED FINAL COSTS/HOURS		10. UNFILLED ORDERS OUTSTANDING
	DURING MONTH		CUM. TO DATE		DETAIL		BALANCE OF CONTRACT			
	ACTUAL a.	PLANNED b.	ACTUAL c.	PLANNED d.	a.	b.	c.	CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	
DIRECT LABOR DOLLARS	.4	.4	122.0	122.0			16.1	138.1	138.1	
FRINGE BENEFITS	0	0	22.2	22.2			2.8	25.0	25.0	
OVERHEAD	.6	.6	102.5	102.5			16.3	118.8	118.8	
OTHER DIRECT COSTS	.5	.5	22.5	22.5			7.1	29.6	29.6	
TOTAL COSTS	1.5	1.5	269.2	269.2			42.3	311.5	311.5	
G-35-607/R6305-0A0										

Questions pertaining to this report should be directed to: Ms. Tammy Putnal (404) 894-6757

G-35-607

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

December 12, 1991

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended November 30, 1991.

If you have any questions or if we can be of further assistance, please call either Tammy Putnal at (404) 894-6757 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies) ✓ M. Stalfe - 1 copy
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT	Budget Bureau No. 104-R0011	11/30/91 20

NASA-LANGLEY RESEARCH CENTER ATTN: MS. SANDRA MURACA FINANCIAL MANAGEMENT, M/S 126 HAMPTON, VA 23665-5225	FROM: GEORGIA TECH RESEARCH CORPORATION P. O. BOX 100117 ATLANTA, GA 30384	3. CONTRACT VALUE a. COSTS $ 370.3	b. FEE $ -0-
1. DESCRIPTION OF CONTRACT — a. TYPE: COST REIMBURSABLE	b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS2-18487	4. FUND LIMITATION $ 311.5	$ -0-
c. SCOPE OF WORK: ERBS/SAGE II	d. AUTH. CONTR. REP. (Signature) — DATE 12/12/91	5. BILLING a. INVOICE AMTS BILLED $ 270	b. TOTAL PYTS REC'D $ 249.1

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
DIRECT LABOR DOLLARS	0	0	122.0	122.0			16.1	138.1	138.1	
FRINGE BENEFITS	0	0	22.2	22.2			2.8	25.0	25.0	
OVERHEAD	0	0	102.5	102.5			16.3	118.8	118.8	
OTHER DIRECT COSTS	0	0	22.5	22.5			7.1	29.6	29.6	
TOTAL COSTS	0	0	269.2	269.2			42.3	311.5	311.5	
					Questions pertaining to this report should be directed to: Ms. Tammy Putnal (404) 894-6757					
G-35-607/R6305-0A0										

Georgia Tech

Office of Grants and Contracts Accounting
Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

January 10, 1992

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended December 31, 1991.

If you have any questions or if we can be of further assistance, please call either Tammy Putnal at (404) 894-6757 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies) 1 mw - 1-AR
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS
12/31/91 17

TO: NASA LANGLEY RESEARCH CENTER ATTN: MS. SANDRA MURACA FINANCIAL MANAGEMENT, M/S 126 HAMPTON, VA 23665-5225	FROM: GEORGIA TECH RESEARCH CORPORATION P. O. BOX 100117 ATLANTA, GA 30384	3. CONTRACT VALUE a. COSTS $ 370.3 b. FEE $ -0-

DESCRIPTION OF CONTRACT			
a. TYPE: COST REIMBURSABLE	b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS2-18487		4. FUND LIMITATION: $ 311.5 / $ -0-
c. SCOPE OF WORK: ERBS/SAGE II	d. AUTH. CONTR. REP. (Signature)	DATE: 01/10/92	5. BILLING: a. INVOICE AMTS BILLED $ 271.7; b. TOTAL PYTS REC'D $ 257.4

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL e.	f.	BALANCE OF CONTRACT g.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
DIRECT LABOR DOLLARS	2.0	2.0	124.0	124.0			14.1	138.1	138.1	
FRINGE BENEFITS	0	0	22.2	22.2			2.8	25.0	25.0	
OVERHEAD	.9	.9	103.4	103.4			15.4	118.8	118.8	
OTHER DIRECT COSTS	(.4)	(.4)	22.1	22.1			7.5	29.6	29.6	
TOTAL COSTS	2.5	2.5	271.7	271.7			39.8	311.5	311.5	

Questions pertaining to this report should be directed to: Ms. Tammy Putnal (404) 894-6757

G-35-607/R6305-0A0

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

February 11, 1992

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended January 31, 1992.

If you have any questions or if we can be of further assistance, please call either Tammy Putnal at (404) 894-6757 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies) 1 C-M WOLFE
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS
01/31/92 21

NASA LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT, M/S 126
HAMPTON, VA 23665-5225

FROM:
GEORGIA TECH RESEARCH CORPORATION
P. O. BOX 100117
ATLANTA, GA 30384

3. CONTRACT VALUE
a. COSTS $ 370.3
b. FEE $ -0-

4. FUND LIMITATION
$ 311.5
$ -0-

DESCRIPTION OF CONTRACT
a. TYPE
COST REIMBURSABLE

b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.
NAS2-18487

c. SCOPE OF WORK
ERBS/SAGE II

d. AUTH. CONTR. REP. (Signature)

DATE
02/11/92

5. BILLING
a. INVOICE AMTS BILLED $ 271.7
b. TOTAL PYTS REC'D $ 269.2

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED				8. ESTIMATED COSTS/HRS. TO COMPLETE			9. ESTIMATED FINAL COSTS/HOURS		10. UNFILLED ORDERS OUTSTANDING
	DURING MONTH		CUM. TO DATE		DETAIL		BALANCE OF CONTRACT			
	ACTUAL a.	PLANNED b.	ACTUAL c.	PLANNED d.	a.	b.	c.	CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	
DIRECT LABOR DOLLARS	2.0	2.0	124.0	124.0			14.1	138.1	138.1	
FRINGE BENEFITS	0	0	22.2	22.2			2.8	25.0	25.0	
OVERHEAD	.9	.9	103.4	103.4			15.4	118.8	118.8	
OTHER DIRECT COSTS	(.4)	(.4)	22.1	22.1			7.5	29.6	29.6	
TOTAL COSTS	2.5	2.5	271.7	271.7			39.8	311.5	311.5	

Questions pertaining to this report should be directed to: Ms. Tammy Putnal (404) 894-6757

G-35-607/R6305-0A0

Georgia Tech

Office of Grants and Contracts Accounting
Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

March 6, 1992

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended February 29, 1992.

If you have any questions or if we can be of further assistance, please call either Tammy Putnal at (404) 894-6757 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Ina Lashley, OCA/PAD, 0420
OCA/CSD, 0420 (2 copies)
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS
02/29/92 20

TO: LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT, M/S 126
HAMPTON, VA 23665-5225

FROM: GEORGIA TECH RESEARCH CORPORATION
P. O. BOX 100117
ATLANTA, GA 30384

3. CONTRACT VALUE
a. COSTS $ 370.3
b. FEE $ -0-

DESCRIPTION OF CONTRACT
a. TYPE: COST REIMBURSABLE
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS2-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature) DATE 03/06/92

4. FUND LIMITATION
$ 311.5 $

5. BILLING
a. INVOICE AMTS BILLED $ 274.7
b. TOTAL PYTS REC'D $ 270.2

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED				8. ESTIMATED COSTS/HRS. TO COMPLETE			9. ESTIMATED FINAL COSTS/HOURS		10. UNFILLED ORDERS OUTSTANDING
	DURING MONTH		CUM. TO DATE		DETAIL					
	ACTUAL a.	PLANNED b.	ACTUAL c.	PLANNED d.	e.	f.	BALANCE OF CONTRACT g.	CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	
DIRECT LABOR DOLLARS	1.4	1.4	125.4	125.4			12.7	138.1	138.1	
FRINGE BENEFITS	0	0	22.2	22.2			2.8	25.0	25.0	
OVERHEAD	1.2	1.2	104.6	104.6			14.2	118.8	118.8	
OTHER DIRECT COSTS	.4	.4	22.5	22.5			7.1	29.6	29.6	
TOTAL COSTS	3.0	3.0	274.7	274.7			36.8	311.5	311.5	

Questions pertaining to this report should be directed to: Ms. Tammy Putnal (404) 894-6757

G-35-607/R6305-0A0

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

April 10, 1992

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended March 31, 1992.

If you have any questions or if we can be of further assistance, please call either Tammy Putnal at (404) 894-6757 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/ttp

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
OCA/CSD, 0420 (2 copies)
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, 0490
File: G35-607/R63050A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

OPERATING DAYS
03/31/92 22

LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT, M/S 126
HAMPTON, VA 23665-5225

FROM:
GEORGIA TECH RESEARCH CORPORATION
P. O. BOX 100117
ATLANTA, GA 30384

3. CONTRACT VALUE
a. COSTS $ 370.3
b. FEE $-0-

DESCRIPTION OF CONTRACT
a. TYPE: COST REIMBURSABLE
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature)
DATE: 4/9/92

4. FUND LIMITATION
$ 311.5 $

5. BILLING
a. INVOICE AMTS BILLED $ 276
b. TOTAL PYTS REC'D $ 270.2

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED – DURING MONTH – ACTUAL a.	DURING MONTH – PLANNED b.	CUM. TO DATE – ACTUAL c.	CUM. TO DATE – PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE – DETAIL a.	DETAIL b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS – CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
DIRECT LABOR DOLLARS	.7	.7	126.2	126.2			11.9	138.1	138.1	
FRINGE BENEFITS	0	0	22.2	22.2			2.8	25.0	25.0	
OVERHEAD	.5	.5	105.1	105.1			13.7	118.8	118.8	
OTHER DIRECT COSTS	0	0	22.5	22.5			7.1	29.6	29.6	
TOTAL COSTS	1.2	1.2	276.0	276.0			35.5	311.5	311.5	
					Questions pertaining to this report should be directed to: Ms. Tammy Putnal (404) 894-6757					
G-35-607/R6305-0A0										

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
404•894•4624; 2629
Fax: 404•894•5519

August 11, 1992

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended July 31, 1992.

If you have any questions or if we can be of further assistance, please call either Peggy Faircloth at (404) 894-6759 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/psf

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Mary Wolfe, OCA/CSD, 0420
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, Michael D. Karp, 0490
File: G35-607/R63050A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 07/31/92 23

TO: LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT, M/S 126
HAMPTON, VA 23665-5225

FROM: GEORGIA TECH RESEARCH CORP.
P. O. BOX 100117
ATLANTA, GA 30384

3. CONTRACT VALUE: a. COSTS $ 370.3 b. FEE $ -0-

4. FUND LIMITATION: $ 370.3 $ -0-

5. BILLING: a. INVOICE AMTS BILLED $ 307.9 b. TOTAL PYTS REC'D $ 289.8

1. DESCRIPTION OF CONTRACT

a. TYPE: COST REIMBURSABLE

b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487

c. SCOPE OF WORK: ERBS/SAGE II

d. AUTH. CONTR. REP. (Signature)

DATE: 08/11/92

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED: DURING MONTH ACTUAL a.	PLANNED b.	CUM. TO DATE ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE: DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS: CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
Direct Labor Dollars	7.4	7.4	141.0	141.0			25.6	166.6	166.6	
Fringe Benefits	1.8	1.8	25.7	25.7			7.2	32.9	32.9	
Overhead	6.3	6.3	117.2	117.2			24.0	141.2	141.2	
Other Direct Costs	1.1	1.1	24.0	24.0			5.6	29.6	29.6	
TOTAL	16.6	16.6	307.9	307.9			62.4	370.3	370.3	

Questions pertaining to this report should be directed to: Ms. Peggy Faircloth (404) 894-6759

G-35-607/R6305-0A0

Baseline Plan Identification (Col. 7b & 7d): Revision No. ______________, Dated ______________.

NASA FORM 533M MAR 75 PREVIOUS EDITION MAY BE USED.

RCS10PUBL00417

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
USA
404•894•4624; 2629
Fax: 404•894•5519

October 12, 1992

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended September 30, 1992.

If you have any questions or if we can be of further assistance, please call either Peggy Faircloth at (404) 894-6759 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/psf

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Mary Wolfe, OCA/CSD, 0420
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, Michael D. Karp, 0490
File: G35-607/R63050A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 09/30/92 22

TO: LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT, M/S 126
HAMPTON, VA 23665-5225

FROM: GEORGIA TECH RESEARCH CORP.
P. O. BOX 100117
ATLANTA, GA 30384

3. CONTRACT VALUE: a. COSTS $ 370.3 b. FEE $ -0-

1. DESCRIPTION OF CONTRACT
a. TYPE: COST REIMBURSABLE
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature) DATE: 10/12/92

4. FUND LIMITATION: $ 370.3 $ -0-

5. BILLING: a. INVOICE AMTS BILLED $ 312.4 b. TOTAL PYTS REC'D $ 307.9

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED During Month Actual a.	Planned b.	Cum. to Date Actual c.	Planned d.	8. ESTIMATED COSTS/HRS. TO COMPLETE Detail a.	b.	Balance of Contract c.	9. ESTIMATED FINAL COSTS/HOURS Contractor Estimate a.	Contract Value b.	10. UNFILLED ORDERS OUTSTANDING
DIRECT LABOR DOLLARS	1.0	1.0	143.9	143.9			22.7	166.6	166.6	
FRINGE BENEFITS	0	0	25.7	25.7			7.2	32.9	32.9	
OVERHEAD	.5	.5	118.8	118.8			22.4	141.2	141.2	
OTHER DIRECT COSTS	0	0	24.0	24.0			5.6	29.6	29.6	
TOTAL	1.5	1.5	312.4	312.4			57.9	370.3	370.3	
			QUESTIONS PERTAINING TO THIS REPORT SHOULD BE DIRECTED TO: Ms. Peggy Faircloth (404) 894-6759							
G-35-607/R6305-0A0										

Baseline Plan Identification (Col. 7b & 7d): Revision No. ______, Dated ______.

NASA FORM 533M MAR 73 PREVIOUS EDITION MAY BE USED.

RCS19PUBL00417

G35-607

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
USA
404•894•4624; 2629
Fax: 404•894•5519

January 14, 1993

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended December 31, 1992.

If you have any questions or if we can be of further assistance, please call either Peggy Faircloth at (404) 894-6759 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/psf

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Mary Wolfe, OCA/CSD, 0420
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, Michael D. Karp, 0490
File: G35-607/R63050A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION **MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT**	Form Approved Budget Bureau No. 104-R0011	2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS 12/31/92 23

TO:	FROM:	3. CONTRACT VALUE	
LANGLEY RESEARCH CENTER ATTN: MS. SANDRA MURACA FINANCIAL MANAGEMENT DIVISION, M/S 126 HAMPTON, VA 23665-5225	GEORGIA TECH RESEARCH CORP. P. O. BOX 100117 ATLANTA, GA 30384	a. COSTS $ 370.3	b. FEE $ -0-

1. DESCRIPTION OF CONTRACT				
a. TYPE COST REIMBURSABLE	b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO. NAS1-18487		4. FUND LIMITATION $ 370.3	$ -0-
c. SCOPE OF WORK ERBS/SAGE II	d. AUTH. CONTR. REP. *(Signature)*	DATE 01/14/93	5. BILLING a. INVOICE AMTS BILLED $ 352.9	b. TOTAL PYTS REC'D $ 312.5

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED: DURING MONTH ACTUAL a.	DURING MONTH PLANNED b.	CUM. TO DATE ACTUAL c.	CUM. TO DATE PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE: DETAIL a.	DETAIL b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS: CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
DIRECT LABOR DOLLARS	8.2	8.2	168.4	168.4			0	168.4	168.4	
FRINGE BENEFITS	.5	.5	27.3	27.3			5.6	32.9	32.9	
OVERHEAD	4.8	4.8	133.2	133.2			6.2	139.4	139.4	
OTHER DIRECT COSTS	0	0	24.0	24.0			5.6	29.6	29.6	
TOTAL	13.5	13.5	352.9	352.9			17.4	370.3	370.3	

Questions pertaining to this report should be directed to: Ms. Peggy Faircloth (404) 894-6759

G-35-607/R6305-0A0

Baseline Plan Identification (Col. 7b & 7d): Revision No. __________, Dated __________.

G35-607

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
USA
404•894•4624: 2629
Fax: 404•894•5519

February 8, 1993

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended January 31, 1993.

If you have any questions or if we can be of further assistance, please call either Peggy Faircloth at (404) 894-6759 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/psf

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Mary Wolfe, OCA/CSD, 0420
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, Michael D. Karp, 0490
File: G35-607/R63050A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 01/31/93 21

TO: LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT DIVISION, M/S 126
HAMPTON, VA 23665-5225

FROM: GEORGIA TECH RESEARCH CORP.
P. O. BOX 100117
ATLANTA, GA 30384

3. CONTRACT VALUE — a. COSTS: $ 370.3 — b. FEE: $ -0-

1. DESCRIPTION OF CONTRACT
- a. TYPE: COST REIMBURSABLE
- b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
- c. SCOPE OF WORK: ERBS/SAGE II
- d. AUTH. CONTR. REP. (Signature)
- DATE: 02/08/93

4. FUND LIMITATION: $ 370.3 — $ -0-

5. BILLING — a. INVOICE AMTS BILLED: $ 356.6 — b. TOTAL PYTS REC'D: $ 339.4

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED — DURING MONTH — ACTUAL a.	PLANNED b.	CUM. TO DATE — ACTUAL c.	PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE — DETAIL a.	b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS — CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
DIRECT LABOR DOLLARS	1.9	1.9	170.3	170.3			(1.9)	168.4	168.4	
FRINGE BENEFITS	.5	.5	27.8	27.8			5.1	32.9	32.9	
OVERHEAD	1.3	1.3	134.5	134.5			4.9	139.4	139.4	
OTHER DIRECT COSTS	0	0	24.0	24.0			5.6	29.6	29.6	
TOTAL	3.7	3.7	356.6	356.6			13.7	370.3	370.3	
G-35-607/R6305-0A0										

Questions pertaining to this report should be directed to:
Ms. Peggy Faircloth (404) 894-6759

Baseline Plan Identification (Col. 7b & 7d): Revision No. ____________, Dated ____________.

G35-607

Georgia Tech

Office of Grants and Contracts Accounting

Georgia Institute of Technology
Hinman Building
Atlanta, Georgia 30332-0259
USA
404•894•4624; 2629
Fax: 404•894•5519

March 30, 1993

Ms. Sandra Muraca
NASA Langley Research Center
Financial Management Division
M/S 126
Hampton, VA 23665

RE: NAS1-18487 Financial Management Report

Dear Ms. Muraca:

Enclosed is the Monthly Contractor Financial Management Report for Contract Number NAS1-18487 for the period that ended February 28, 1993.

If you have any questions or if we can be of further assistance, please call either Peggy Faircloth at (404) 894-6759 or me at (404) 894-2629.

Sincerely,

David V. Welch
Director

DVW/psf

Enclosure

cc: Dr. W. L. Chameides, E & A Sci, 0340
Dr. D. M. Cunnold, E & A Sci, 0340
Ms. Luci Blunschi, E & A Sci, 0340
Ms. Wanda Simon, OCA/CSD, 0420
Mr. George Maddrea, Tech Rep, M/S 475
Cost Accounting, M/S 135 via (M/S 175) via (DCAA)
ONR RR, Michael D. Karp, 0490
File: G35-607/R63050A0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MONTHLY CONTRACTOR FINANCIAL MANAGEMENT REPORT

Form Approved
Budget Bureau No. 104-R0011

2. REPORT FOR MONTH ENDING AND NUMBER OF OPERATING DAYS: 02/28/93 20

LANGLEY RESEARCH CENTER
ATTN: MS. SANDRA MURACA
FINANCIAL MANAGEMENT DIVISION, M/S 126
HAMPTON, VA 23665-5225

FROM:
GEORGIA TECH RESEARCH CORP.
P. O. BOX 100117
ATLANTA, GA 30384

3. CONTRACT VALUE
a. COSTS $ 370.3
b. FEE $ -0-

DESCRIPTION OF CONTRACT
a. TYPE: COST REIMBURSABLE
b. CONTRACT NO. AND LATEST DEFINITIZED AMENDMENT NO.: NAS1-18487
c. SCOPE OF WORK: ERBS/SAGE II
d. AUTH. CONTR. REP. (Signature) DATE 03/30/93

4. FUND LIMITATION $ 370.3 $ -0-

5. BILLING
a. INVOICE AMTS BILLED $ 356.6
b. TOTAL PYTS REC'D $ 356.6

6. REPORTING CATEGORY	7. COSTS INCURRED/HOURS WORKED – DURING MONTH – ACTUAL a.	DURING MONTH – PLANNED b.	CUM. TO DATE – ACTUAL c.	CUM. TO DATE – PLANNED d.	8. ESTIMATED COSTS/HRS. TO COMPLETE – DETAIL a.	DETAIL b.	BALANCE OF CONTRACT c.	9. ESTIMATED FINAL COSTS/HOURS – CONTRACTOR ESTIMATE a.	CONTRACT VALUE b.	10. UNFILLED ORDERS OUTSTANDING
DIRECT LABOR DOLLARS	0	0	170.3	170.3			(1.9)	168.4	168.4	
FRINGE BENEFITS	0	0	27.8	27.8			5.1	32.9	32.9	
OVERHEAD	0	0	134.5	134.5			4.9	139.4	139.4	
OTHER DIRECT COSTS	0	0	24.0	24.0			5.6	29.6	29.6	
TOTAL	0	0	356.6	356.6			13.7	370.3	370.3	
G-35-607/R6305-0A0										

Questions pertaining to this report should be directed to:
Ms. Peggy Faircloth (404) 894-6759

Baseline Plan Identification (Col. 7b & 7d): Revision No. ________, Dated ________.

G-35-609

A Trip Report on

The Quadrennial Ozone Symposium
Gottingen, West Germany
August, 1988

by

Derek M. Cunnold
School of Geophysical Sciences
Georgia Institute of Technology
Atlanta, GA 30332-0340

The Quadrennial Ozone Symposium, 1988

The attendance at the quadrennial ozone symposia has increased from approximately 60 scientists in 1961 to 120 scientists in 1972 to approximately 400 in Gottingen this year. Current interest is centered on the antarctic ozone hole (and its arctic counterpart?), global trends in stratospheric ozone, and this year, for the first time, ozone in the troposphere. Approximately three working days (out of 7 1/2 days) at this meeting were devoted to the troposphere, and it is clear that there is now considerable political and regulatory interest (and financial support?) throughout the U.S. and Western Europe for understanding elevated ozone levels in the troposphere.

Ozone in the troposphere

Production of ozone in the troposphere occurs through the now well-known set of reactions:

$$\begin{array}{lrcl}
 & CO + OH & \rightarrow & CO_2 + H \\
 & H + O_2 + M & \rightarrow & HO_2 + M \\
 & HO_2 + NO & \rightarrow & NO_2 + OH \\
 & NO_2 + h\nu & \rightarrow & NO + O \\
 & O + O_2 + M & \rightarrow & O_3 + M \\
\hline
\text{sum} & CO + 2O_2 & \rightarrow & CO_2 + O_3
\end{array}$$

This set of reactions can produce ozone throughout the troposphere provided NO concentrations are greater than 10 pptv. For NO concentrations less than this, the third reaction is less important than $HO_2 + O_3 \rightarrow OH + 2O_2$ and the reaction set becomes a sink for ozone. Hence, NO_x concentrations must be known in order to assess tropospheric ozone production.

In continental polluted air, CO in the reaction set may be replaced by CH_4 or non-methane-hydrocarbons (NMHC). Again, however, the concentrations of NO_x (due to both natural and anthropogenic sources) are critical for assessing resulting ozone concentrations. Regulatory control strategies based on hydrocarbon emissions in the U.S. appear to be having only modest effects on controlling ozone production because of the role of NO_x. In Europe, on the other hand where emission controls are just beginning, controls on hydrocarbon emissions might have a more important role in limiting the local production of ozone.

At the ozone symposium the emphasis was on the global ozone budget of the troposphere. Despite observational evidence of elevated ozone levels produced by biomass burning (particularly evident just above the boundary layer over West Africa) and by industrial emissions in continental areas, it remains unclear what proportion of the tropospheric ozone comes from the stratosphere and versus how much is photochemically produced. The separation of these two sources is made more difficult because both processes result in more tropospheric ozone in the Northern Hemisphere and even the well-known tendency for stratospheric intrusions to produce a spring maximum in ozone can be replicated by the production of ozone from PAN (which has a long lifetime) in the spring. Because of these difficulties there is considerable interest in historical ozone data and in data from extremely remote areas such as the antarctic.

Surface ozone measurements from Montsouris (near Paris) in the 1890's, after being filtered for SO_2 contamination, yielded ozone mixing ratios of approximately 10 ppbv with only a slight indication of a spring maximum. This may be contrasted against current annually-averaged values at Hohenpeissenberg of 30 ppbv with a seasonal variation (summer maximum) of ± 10 ppbv. A one-dimensional model was able to account for such an ozone change over the past century only if NMHC of natural origin were contributing to the tropospheric ozone balance in 1900.

Latitudinal surveys of tropospheric ozone showed surface ozone levels in the Southern Hemisphere to be approximately half the levels found in the Northern Hemisphere. In the tropics (away from biomass burning areas) surface concentrations are only 10 ppbv because of local chemical destruction by HO_x with a time constant (~ 10 days) significantly faster than the downward mixing time. Similarly low concentrations are also observed at high latitudes of the Southern Hemisphere. There was some evidence of more fragment stratospheric intrusions in the Northern Hemisphere resulting in more pronounced springtime ozone maxima over the oceans in the Northern Hemisphere than in the Southern Hemisphere. South Pole values are somewhat larger than the Montsouris values of 100 years ago raising the question of whether the SP values are pre-industrial? Using the GFDL three-dimensional model, Levy finds that fossil fuel combustion does not supply sufficient NO_x to the Southern Hemisphere to produce a source of ozone. A biomass-burning source of NO_x may add significantly to NO_x in the SH and explain maritime boundary layer measurements of nitrate and nitric acid in the South Pacific. Stratospheric injections of NO_x can add NO_x in the upper troposphere.

Measurements of NO_x are needed to assess the ozone budget of the Southern Hemisphere. Some analyses of the Northern Hemisphere NO_x budget were presented at this meeting. NO_x is observed to decrease slowly with height in continental air but to increase with height in maritime air. Measurements of the known chemical component ratios of NO_x were found to add to unity in some experiments but not in others. PAN contributes approximately 30% of the daytime NO_x over the continental U.S. (its rate of destruction has a strong temperature dependence). Measured ratios of NO_x to ozone are being used to assess intrusions of stratospheric air into the upper troposphere and the lightning source of NO_x.

Several field experiments comparing observed changes in ozone against changes predicted by chemical models based on measurements of precursor species, HO_x, NO_x, and NMHC were reported. Measurements (at roughly hourly intervals) during relatively static conditions over a four day period in central

Pennsylvania were impressively simulated. The diurnal variation in vertical mixing in the boundary layer provides large morning NO_x concentrations (by downward mixing) for initiating ozone production. Other measurements indicated a substantial chemical source of tropospheric O_3 over the central U.S. in the summertime (~ 10^{12} mol/cm^2/sec) which may increase during conditions of deep convective mixing by an order of magnitude. However simulations of ozone change when horizontal transport is important remain unconvincing both because of difficulties in assessing the transport and substantially offsetting effects of chemical change and deposition to the ground.

Trend studies of tropospheric ozone from ECC sonde data show irregular increases over the past 20 years of 1-3%/year. The larger increases occur over Western Europe, and it is the daytime values which have increased. Future increases are projected but are obviously sensitive to future levels of CH_4, CO and NO_x. Isaksen projects there should have been a global tropospheric ozone increase of roughly 25% since 1960 (primarily in the Northern Hemisphere) and a decrease in OH of 15%. Over the next 100 years an additional ozone increase of 10-20% is projected. Ann Thompson pointed out that projected reductions of O_3 in the stratosphere should result in more tropospheric OH and a reduction in the tropospheric ozone increase. J. Chang emphasized that net long term changes in OH are also affected by NMHC emissions.

Stratospheric Ozone

(a) Polar region

The antarctic ozone hole is being explained in terms of high ClO levels resulting from the reaction sequence:

$$ClNO_3 + HCl \xrightarrow{ice} Cl_2 + HNO_3 \text{ (solid)} \quad (1)$$
$$ClO + NO_2 + M \rightarrow ClNO_3 + M \quad (2)$$
$$Cl_2 + h\nu \rightarrow 2Cl \quad (3)$$
$$Cl + O_3 \rightarrow ClO + O_2 \quad (4)$$

Thus in the polar night in the presence of polar stratospheric clouds, Cl_x is being stored as Cl_2, not $ClNO_3$ or HCl. Photodissociation of Cl_2 results in a net conversion of HCl to ClO. Ozone destruction occurs via the ClO dimer reaction sequence:

$$ClO + ClO + M \rightarrow ClOOCl + M \quad (5)$$
$$ClOOCl + h\nu \rightarrow Cl + ClOO \quad (6)$$
$$ClOO + M \rightarrow Cl + O_2 + M \quad (7)$$
$$Cl + O_3 \rightarrow ClO + O_2 \quad (8)$$

At this conference Dr. Cox reported a fast and highly temperature sensitive rate constant of $4.2 \times 10^{-30} \exp(8720/T)$ cm^3/sec for reaction (5) and that reaction (6) is the major photolysis channel for Cl_2O_2. Molina emphasized that HCl dissolves in ice so that reaction (1) can be a fast reaction because it is just a two body reaction. Also $HNO_3.nH_2O$ forms several degrees above the frost point of water and HCl reacts fast with this. Furthermore, PSC's can promote reactions between otherwise stable species such as

$$H_2O_2 + HCl \xrightarrow[\text{ice}]{} HOCl + H_2O$$

which is another way for HCl to be converted to ClO.

DeZafra reported ClO concentrations of 3×10^9 cm^{-3} at approximately 20 km altitude and column measurements of 2×10^{15} cm^{-2} by day dropping to 10^{13} cm^{-2} at night. Disappearance of the ClO layer centered at 20 km occurred almost immediately at sunset. Destruction of ozone via reaction sequence (5-8) is controlled by reaction (5), which explains why O_3 depletion occurs throughout the 10-22 km altitude range. He estimates that reaction (5) leads to 50% too much ozone destruction (which is good agreement considering rate constant uncertainties and concern about whether the diurnal variation of ClO was adequately accounted for in that estimate). Ozone concentrations are found to be negatively correlated with ClO concentrations two weeks after the antarctic has emerged from polar night. Despite the non-linear dependence of ozone destruction on ClO, the AER modeling group have however concluded that it has not been possible to simulate both the seasonal cycle in antarctic ozone and the secular change between 1979 and 1987 (but have they included the observed temperature changes in their calculations?).

The aircraft flights (e.g. the ER-2) into the ozone hole in 1987 have shown that HCl concentrations decrease below HF concentrations on entering the ozone hole region. HNO_3, NO_2, and H_2O are also lower (~ 2 times) inside this region than outside while $ClNO_3$ appears to have a peak near the edge of the region. It was suggested that the rapid increase of ClO inside the region be used to define the edge of the chemical vortex (ClO = 130 pptv?) which extends over a somewhat broader area than the dynamically-defined vortex. The species with low concentrations (e.g. HCl and NO_2) inside the vortex begin to increase in mid-September as the vortex warms. Measured BrO column concentrations are 3×10^{13} cm^{-2} with an estimated layer height of 15 km and a concentration of 5-10 pptv. This implies that bromine plays only a minor role in ozone destruction but is responsible for producing large observed columns of OClO with maximum values during the evening hours.

Destruction of ozone in the antarctic appears initially in the vicinity of the polar night boundary and spreads poleward as this boundary contracts. By October 1st the ozone variance over Halley Bay is small suggesting fairly uniform ozone destruction has occurred throughout the polar region with 80% of the ozone between 13 and 22 km having been destroyed. Measurements of long-lived trace gases (e.g. N_2O) indicate that the air inside the polar vortex persistently sinks during the spring. Several three-dimensional models have been used to study the recovery of ozone at the end of spring, but Prather finds transport is insufficient to fill in the hole. In a 2-D model (Ko et al) calculation it is noted that this transport of ozone into the hole can be responsible for an annually-averaged observed decrease of approximately 5% at

40-60°S latitude (but this decrease would be non-accumulative). The ozone hole in 1987 lasted into December because of a later than normal breakup of the polar vortex. In the arctic there is some evidence of chlorine chemistry such as high OClO values but less isolation from mid-latitude transport (both ozone and heat) may be reducing the effects.

Kawahira analyzed NMC temperatures in the 100-200 mb and 50-100 mb regions. As has been previously noted, there has been a reduction in temperatures in the July, August, September period between 1979 and 1986, and in particular the region with temperatures less than 195° k has widened considerably. He attempted to relate these changes to a reduction in the poleward heat flux. Such studies lead to questions of whether there has been a secular change in PSC's over this period and whether O_3 and CO_2 changes are contributing to this temperature change and hence to the ozone hole.

(b) Stratospheric ozone trends

The trends report concludes that there has been a decrease of columnar ozone at mid-latitudes of the Northern Hemisphere of approximately 6% since 1979 (why should an effect due to fluorocarbons have started in 1979?). In the stratosphere the report concludes there is no unique way to correct for diffuser plate degradation in the SBUV experiment, and although the trends inferred from SAGE and Umkehr observations are roughly in agreement with the expected ozone loss of 10%, sampling uncertainties render the observed trends as tentative. There is considerable uncertainty concerning the effects of the 11 year solar cycle on ozone and therefore considerable interest in what will happen to the ozone as solar maximum approaches over the next few years.

Bhartia feels that it is possible, by comparing long term changes in the SBUV wavelength pairs used to infer total ozone and changes as a function of air mass, to remove diffuser plate effects on total ozone. SBUV trends are then similar to those from the Dobson network. Some uncertainties remain due to the effect of clouds. SBUV stopped producing good data on February 13, 1987. Preliminary results from SBUV2 for March, April, and December 1985 showed differences relative to SBUV and Umkehr of 5-10%. Some of the differences from SBUV were clearly related to air mass differences (and hence to diffuser plate or absorption coefficient uncertainties). Stolarski reported that TOMS observations, normalized to the Dobson network, exhibited a 3% global ozone change over the 10 year period 1978-1988, of which approximately 0.5% was due to the antarctic ozone hole. The change varies by season and latitude and is different in the Northern and Southern Hemispheres. The largest changes in the Northern Hemisphere are in the polar region (e.g. in October) but vary with longitude there in association with wave 1 vortex structure.

Based on aerosol size distribution measurements by the ER-2 aircraft and lidar measurements at five Northern Hemisphere sites, DeLuisi has recalculated the effects of aerosols on Umkehr measurements (-5% error/.01 in aerosol optical thickness for layer 9 ozone). At five selected Northern Hemisphere sites this implies a 10% ozone reduction in layers 8 and 9 over the recent 10 year period (with the minimum change occurring in layer 5). Mateer has inferred expected differences between Umkehr and SBUV measurements based on the averaging kernels for the two experiments and the SAGE (high vertical resolution) ozone profiles. The Boulder Umkehr and SBUV exhibit the expected differences (Umkehr layers 3-6 have well-known problems produced by the first guess profiles) with layer 5 values exhibiting particularly poor correlation (in part because ozone doesn't vary much at that level).

Solar cycle effects on ozone have been inferred from analyses of the observed effects of the 27 day solar rotation period on ozone. An underprediction of the ozone response occurs above 40 km altitude even after a diurnal correction has been made. It is hypothesized (Hood and Keating) that this is due to an underprediction of the phase lag for the temperature response which can produce a positive feedback on the ozone response. Hood concludes that the maximum effect of the solar cycle on the total ozone change from 1979 to 1985 is 1% but it was noted that the temperature response is time-limited in a 27 day period which would not be true for an 11 year solar cycle. A 2-D model calculation by Wuebbles on the other hand predicts that more than half the ozone change observed since 1979 should have been due to the solar cycle effect; at 42 km altitude 3% of the 10% ozone change is predicted to be due to the solar cycle (with the fluorocarbon effect being latitude-dependent and the solar cycle effect latitude-independent). The model gives good agreement with the observed stratospheric temperature change of 1.5-2°k but is unable to simulate the observed wintertime change of columnar ozone at mid-latitudes of 6%.

A range of models is being used to assess ozone change and some measurements and predicted effects of CFC-22, which some in Europe consider to be a likely replacement for the more stable fluorocarbons, were presented at this meeting. 2-D models include K. K. Tung's model which utilizes isentropic surfaces and five day averaged measured NMC temperatures to produce a circulation. Hou pointed out that the ageostrophic advection of angular momentum in the absence of strong quasigeostrophic eddy mixing resolution a steepening of the meridional ozone gradient accompanied by movement of maximum downward velocity in the residual circulation away from the polar region. This is proposed to be the reason why the columnar ozone maximum in the Southern Hemisphere (in winter) is displaced to mid-latitudes. A French GCM with very limited chemistry is being used for ozone studies, as is a hemispheric model at NCAR without a troposphere but with more chemistry. The largest operation is clearly the group at NASA GSFC who are now coupling an extensive chemistry and a full diurnal calculation into their GCM. They have, however, decided not to use a 4th order GCM but are instead using a spectral GCM and assimilating observed temperatures into the model. The model consumes 4 hours of cyber 205 time/model day. The model provides a good simulation of LIMS HNO_3 variations.

Analysis of Ozone Observations (ground–based)

El Nino and Ozone

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Hasebe(1984) studied the interannual variations of total ozone (1970-1977) and found the oscillation with period of about four years (FYO). This FYO is almost symmetric with respect to the equator showing an out-of phase relation between the tropics and the extratropics. Its node is located at about 20 N and 20 S. The sea surface temperature in the equatorial eastern Pacific and the FYO of total ozone have a good correlation. During the warm phase of El Nino, the total ozone in the tropics is low and that in the extratropics is high. It is suggested that when El Nino takes place, the ozone transport in the stratosphere by the Brewer-Dobson circulation is enhanced and therefore the total ozone increases in the extratropics and decreases in the tropics.

In this paper, the impact of El Nino event on the total ozone transport is studied by a atmospheric general circulation model. The model we used is the 15 layer MRI GCM. The simple ozone photochemical process in the stratosphere is included in the model together with an advective process (Schlesinger and Mintz, 1979). Two 3 month integrations are performed from the initial atmospheric condition of 12Z, May 1, 1983. Control run is integrated with use of climatological sea surface temperatures and the other with the observed sea surface temperatures in 1983. During the period, the 1982/83 El Nino was still active. The initial condition of ozone is climatological values for both runs.

Fig. 1 shows the July mean total ozone anomaly (El Nino run - Control run). The simulation clearly shows that the total ozone decreases and that in the middle latitude increases. The anomaly is almost symmetric with respect to the equator and its node lies at about 20 N and 20 S. The simulated results agree with the observation. Thus the relationship between El Nino and the toal ozone variation is comfirmed by the present GCM simulation. Also the simulation in winter will be presented at the symposium.

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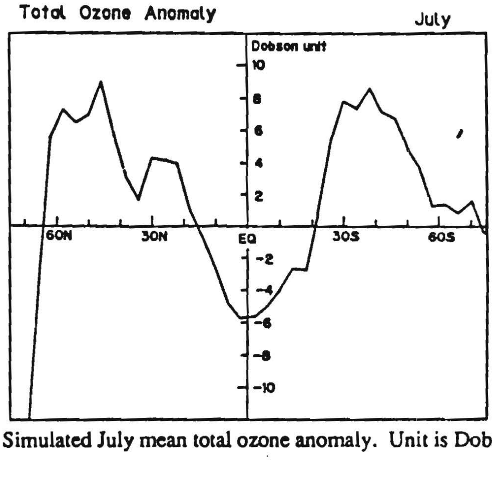

Fig. 1 Simulated July mean total ozone anomaly. Unit is Dobson unit.

Ozone Observations from Satellites

Hemispheric Differences in Observed Stratospheric Ozone

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Analyses are presented of the hemispheric differences of time and longitude variations of stratospheric ozone. The present study is based on 8 years (Nov 1978–Sep 1986) of ozone concentration data as derived from the Nimbus 7 SBUV measurements. The results are consistent with, and an extension of, preliminary results reported from earlier, limited, data sets.

At 1 mb, during the winter season, the Southern Hemisphere ozone mixing ratio is considerably higher (about 30 percent) than that in the Northern Hemisphere. This is, at least in part, the result of the photochemical response to the lower temperature at mid and high latitudes in the Southern Hemisphere. During the peak of the summer season (Jun–Jul/Dec–Jan) the Northern Hemisphere mixing ratio values are about 15–20 percent higher than those in the Southern Hemisphere. Approximate balance obtains at all latitudes at 1 mb during Mar(N)/Oct(S) and Sep(N)/Mar(S). In the upper stratosphere the annual variations are maxima at about 60°N and 45–60°S but the maximum phases are just 6 months apart—Dec(N) and Jun(S).

The ozone mixing ratio at 10 mb is almost always higher in the Northern Hemisphere—particularly at sub-polar latitudes. However, near equatorial latitudes, where the effect of the earth–sun distance is important, the sign of the difference alternates from perhelion to aphelion. In mid-stratosphere (7–10 mb) the annual variations show about equal maxima at about 50°N and S. At lower levels (30–40 mb) the amplitude of the annual harmonic at sub-polar latitudes is slightly higher in the Northern Hemisphere, and in the Southern Hemisphere the phase is retarded about 2–3 months at sub-polar latitudes.

Longitude variations at different stratospheric levels also indicate hemispheric differences. At 1 mb wave #1 is dominant with an amplitude of ~0.5 ppmm during the winter at 65°N and 40°S. At lower levels, the maximum amplitude is ~0.8 ppmm at 65°N and ~4.5 ppmm at 45–60°S.

The importance of photochemical and stratospheric circulation characteristics as they affect these observed hemispheric differences will be discussed.

Satellite Total Ozone Climatology Covering 18 Years

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Satellite total ozone observations have been analyzed from both the BUV on Nimbus-4 and SBUV on Nimbus-7. The former covered the period 1970 to 1977 while the latter covered the period 1979 to 1986. The purpose of this paper is to study the global ozone variations by season over the 18 year period. This was accomplished by first employing Nimbus-4 and Nimbus-7 data which were processed by the same algorithm, removing the long term trends which may be instrument induced, and then forming monthly 10 degree zonal averages. The annual, semiannual, quasibiennial oscillations (QBO) from the two data sets were compared by means of harmonic analysis. The two data sets show very

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Final Report for the Period

April 15, 1987 - April 14, 1993

for

Investigations of SAGE II
Ozone and NO_2 Measurements

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April 1993

Publications

1. Validation of SAGE II ozone measurements. J. Geophys. Res., 94(D6), 8447-8460, 1989, (first page enclosed).

2. Validation of SAGE II NO_2 measurements. J. Geophys. Res., 96(D7), 12,913-12,925, 1991, (first page enclosed).

3. Preliminary assessment of possible aerosol contamination effects on SAGE ozone trends in the lower stratosphere. Adv. Space Res., 11, 35-38, 1991, (paper enclosed).

4. Mesospheric ozone measurements by SAGE II. Paper to appear in the Proceedings of the Quadrennial Ozone Symposium, Charlottesville, VA, June, 1992, (copy enclosed).

5. Comparisons between SAGE II and UARS ozone measurements. UARS validation report, April, 1993, (copy of relevant section enclosed).

Current work

Graphics show current activities in the following areas are enclosed.

(1) Comparisons of SAGE II column ozone measurements against TOMS.
- (a) The long term trends are slightly different.
- (b) Similar results are evident for the QBO sampled at SAGE coincidences.

(2) Comparisons against SBUV version 6:

Differences are being examined, with the following conclusions

- (a) Large differences can arise because measurements of temperature were unavailable to SAGE at certain times.
- (b) There exist other sources of large differences occasionally affecting SAGE.
- (c) Following fully sunlit periods, SAGE data possesses questionable values.
- (d) SAGE sunrise data appears to be biased at high altitudes in the tropics.

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Validation of SAGE II Ozone Measurements

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The error budget of the Stratospheric Aerosol and Gas Experiment (SAGE) II ozone profile measurements is discussed in depth. Five ozone profiles are compared against coincident ROCOZ-A and electrochemical concentration cell (ECC) ozonesonde measurements at Natal, Brazil (6°S) and Wallops Island, Virginia (36°N). The mean difference between all the measurements is approximately 1% and the agreement is within 7% at all altitudes between 20 and 53 km. Using datasonde and National Weather Service satellite observations of temperature, the agreement is almost equally as good for ozone mixing ratios on pressure surfaces. A comparison of the intrinsic SAGE II measurement errors with measured tropical variances suggests that the precision of the ozone profiles is approximately 5% between 24 and 36 km, degrading to 7% at an altitude of 48 km. It is inferred that the measurement errors possess a vertical correlation distance of 3 km and that therefore the profile precision improves by a factor of approximately 1.3 if the profiles were to be smoothed over 5 km vertically. The repeatability of SAGE II ozone profiles depends also upon the uncertainty in the profiles' reference altitudes. These errors are correlated over 7-day periods and increase to 200 m over that period of time. The accuracy of SAGE II ozone profiles is expected to be 6% above 25 km altitude. The SAGE II profiles provide useful ozone information up to approximately 60 km altitude and are more precise than the SAGE I profiles. SAGE II profiles, combined with revised SAGE I profiles, form an excellent data base for estimating the long-term trend in stratospheric ozone since 1979.

1. Introduction

The Stratospheric Aerosol and Gas Experiment (SAGE) II experiment is a part of the Earth Radiation Budget Satellite (ERBS), which was launched from the space shuttle October 5, 1984. It was maneuvered into a 610-km circular orbit at an inclination of 56°. The instrument is a seven-channel Sun photometer, similar to the SAGE I instrument [*McCormick et al.*, 1979], that makes measurements at the wavelengths of 1.02, 0.94, 0.60, 0.525, 0.453, 0.448, and 0.385 μm. SAGE II vertically scans the solar surface as the atmosphere on the Earth's limb passes between the Sun and the spacecraft. The ray path from the Sun to the spacecraft traverses the atmosphere at minimum (or tangent) heights between cloud top and maximum heights of 200 km [*Mauldin et al.*, 1985]. The instrument field of view in the direction normal to the ray is 0.5 km vertically by 5 km horizontally.

Ozone concentration profiles are retrieved from the irradiance measurements in the 0.6-μm channel, which is located at the center of the Chappuis absorption band. The inversion of the radiometric data involves the removal of contributions from molecular scatterers, NO_2, and aerosol [*Chu et al.*, this issue]. SAGE II performs 15 sunset and 15 sunrise measurements each day. Because of the orbital characteristics of the ERBS spacecraft, the spatial coverage of the SAGE II measurements extends over a seasonally dependent latitude range of approximately 70°S to 70°N over the period of about 1 month. The annual latitudinal coverage of the SAGE II measurements is shown in Figure 1 (for SAGE II, the sample locations and times repeat from year to year). SAGE II ozone data, together with the aerosol, NO_2, and H_2O data, are processed at NASA Langley Research Center, Hampton, Virginia, and are archived at the National Space Science Data Center (NSSDC) at NASA Goddard Space Flight Center, Greenbelt, Maryland.

The objective of this paper is to test the validity of the ozone measurements from the SAGE II instrument. The approach is similar to that used for the validation of the SAGE I ozone data [*McCormick et al.*, 1984; *Reiter and McCormick*, 1982] and is based primarily on comparisons with correlative measurements by both rocket ozonesondes and electrochemical concentration cell (ECC) ozonesondes. A detailed analysis of the SAGE II ozone profile errors is also included to assess the precision of each of the measurements.

2. The Ozone Retrieval Algorithm

The procedure for retrieving ozone from SAGE II irradiances [*Chu et al.*, this issue] is similar in approach to that for SAGE I, described by *Chu and McCormick* [1979]. However, in the SAGE II algorithm the tangent altitude corresponding to each measurement is determined solely from the satellite ephemeris and the inferred scanning rate of the scan mirror. This contrasts with SAGE I, in which tangent altitudes in the most recent, 1987-produced, data set are determined primarily by matching measured molecular densities at approximately 30 km altitude against meteorological data from the National Weather Service (NWS) (with only minimal constraints being applied, based on the satellite ephemeris information).

The algorithm first establishes the position of each SAGE II measurement, both in the atmosphere (expressed as the tangent altitude relative to Earth's sea level) and on the Sun. A Sun scan for a tangent altitude of approximately 120 km is used as a reference relative to which atmospheric transmissions are inferred. The scan mirror moves back and forth across the Sun 20–30 times during an event. Slant path atmospheric transmissions determined at each instant are grouped into 70 consecutive 1-km altitude bins, beginning at the lowest measurement altitude. For each event the arithmetic means of the measured optical depths at each altitude are computed. The estimated uncertainty in the optical depth

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Validation of SAGE II NO_2 Measurements

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Stratospheric aerosol and gas experiment (SAGE) II satellite-borne measurements of the stratospheric profiles of NO_2 at sunset have been made since October 1984. The measurements are made by solar occultation and are derived from the difference between the absorptions in narrow bandwidth channels centered at 0.448 and 0.453 μm. The precision of the profiles is approximately 5% between an upper altitude of 36 km and a latitude-dependent lower altitude at which the mixing ratio is 4 ppbv (for example, approximately 25 km at mid-latitudes and 29 km in the tropics). At lower altitudes the precision is approximately 0.2 ppbv. The profiles are nominally smoothed over 1 km except at altitudes where the extinction is less than 2×10^{-5}/km (approximately 38 km altitude), where 5 km smoothing is employed. The profile measurement noise has an autocorrelation distance of 3–5 km for 1 km smoothing and more than 10 km for 5 km smoothing. The absolute accuracy of the measurements is estimated to be 15% based on uncertainties in the absorption cross-sections and their temperature dependence. Comparisons against two sets of balloon profiles and atmospheric trace molecules spectroscopy experiment (ATMOS) measurements show agreement within approximately 10% over the altitude range of 23 to 37 km at mid-latitudes. SAGE II NO_2 measurements are calculated to be approximately 20% smaller at the mixing ratio peak than average limb infrared monitor of the stratosphere (LIMS) measurements in the tropics in 1979. They show acceptable agreement with SAGE I sunset NO_2 measurements in the tropics in 1979–1981 when the limited resolution and precision of the SAGE I measurements and the differences between the two measurement techniques are considered.

1. INTRODUCTION

The stratospheric aerosol and gas experiment (SAGE) II instrument was launched from the space shuttle on October 5, 1984. It was maneuvered into a 610-km circular orbit with an inclination of 56°. The instrument is a seven channel Sun photometer which makes measurements at the wavelengths of 1.02, 0.94, 0.60, 0.525, 0.453, 0.448, and 0.385 μm. The instrument scans back and forth across the solar disk as the Sun is occulted by the Earth's atmosphere. One product of these measurements is NO_2 profiles at a 90° solar zenith angle (sunrises and sunsets) at the points where the line of sight from the instrument to the Sun are tangential to the Earth's atmosphere. The instrument field of view in the direction normal to the line of sight is 0.5 km vertically by 2.5 km horizontally.

NO_2 profiles are retrieved on the basis of the difference between the measured irradiances at 0.448 and 0.453 μm (i.e., a differential technique). Using two wavelengths produces good separation of the NO_2 absorption signature from that of other gases and scatterers and makes the technique conceptually similar to the NO_2 measurement technique (which however utilizes many more wavelengths) which has been used to produce many years of ground-based NO_2 measurements [e.g., *Noxon*, 1979, 1980; *Johnston and McKenzie*, 1988] and more recently to make balloon-borne NO_2 measurements [e.g., *Pommereau et al.*, 1987]. Contributions from ozone, aerosols, and neutral density must be removed before the NO_2 profiles can be obtained. The latitude of the NO_2 profiles (and the other atmospheric constituents, aerosols, ozone, and water vapor) observed by SAGE II change from one day to the next such that sampling of the global atmosphere between approximately 70°N and 70°S is produced over a 1-year period (see Figure 1). The orbit of SAGE II is such that the coverage of the global atmosphere is exactly repeated each 364.44 days. The SAGE II data are processed at NASA Langley Research Center, Hampton, Virginia, and are being archived at the National Space Science Data Center (NSSDC) at NASA Goddard Space Flight Center, Greenbelt, Maryland.

The objective of this report is to test the validity of the SAGE II NO_2 measurements within the measurement accuracy of approximately 15%. This is also the estimated (approximate) accuracy of the measurement systems against which the SAGE II NO_2 measurements will be compared. There are, unfortunately, only a few (almost) coincident balloon-borne measurement of NO_2, and thus validation must also depend upon comparisons against climatological distributions of NO_2 and on the self-consistency of the observations.

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2. NO_2 RETRIEVALS

The general procedure for retrieving constituent profiles from the SAGE II irradiance measurements is described by *Chu* [1989] and *Chu et al.* [1989]. The algorithm is based on the set of equations:

$$\tau(\lambda_i) = \tau_a(\lambda_i) + a\tau_{O_3}(\lambda_i) + b\tau_{NO_2}(\lambda_i) + \tau_r(\lambda_i) \quad (1)$$

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PRELIMINARY ASSESSMENT OF POSSIBLE AEROSOL CONTAMINATION EFFECTS ON SAGE OZONE TRENDS IN THE LOWER STRATOSPHERE

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ABSTRACT

An investigation of the validity of long term ozone trends in the lower stratosphere derived from SAGE I and II measurements is described. At altitudes below approximately 20 km, it is important to separate the ozone and aerosol contributions to SAGE extinction at 600 nm. The correlation between SAGE II measurements of ozone and aerosols indicates that most of the variability in these parameters is associated with physically induced variations resulting from quasi-horizontal motions of air parcels. The SAGE ozone measurements are however found to be as much as 20% larger than coincident ozonesonde measurements between 15 and 20 km altitude. A sudden change in the difference at approximately 14.5 km altitude for which there is a change in the SAGE aerosol retrieval procedure suggests that SAGE ozone trends below 20 km altitude may be more sensitive to aerosol variations. Between 20 and 25 km altitude, however, both SAGE and the ozonesondes indicate a reduction in ozone of approximately 0.5%/year over the period 1979 to 1989 at mid-latitudes of the Northern Hemisphere.

INTRODUCTION

SAGE I and II satellite observations have provided important information on long term changes in stratospheric ozone (e.g. /1/). The changes reported up until this time have emphasized the region above 25 km altitude both because of the possibility of contamination of the ozone signal by aerosols below this altitude (see for example, /2/) and because it is more difficult to validate the ozone observations below 25 km altitude because of the expected short time and space scales of ozone variability in the lower stratosphere. Nevertheless, it is important to assess long term ozone change in the lowest part of the stratosphere, especially because the ozonesonde observations suggest that a substantial decrease has occurred in this region over the past decade. This report is part of an ongoing study of ozone change in the lower stratosphere implied by SAGE I and II observations.

Several approaches have been taken in this assessment. Correlations between the coincident ozone and aerosol observations have been examined for spurious correlations which might be produced by retrieval uncertainties. Variations on both orbit to orbit and month to month time scales are being studied. It is not, however, easy to identify a spurious correlation in the month to month variations because of the large seasonal cycle in ozone at mid-latitudes and the quasi-biennial oscillation in the tropics which unfortunately has a phase which is correlated with volcanic aerosol injections into the stratosphere in the mid 1980's. On the other hand, we observe large orbit to orbit aerosol variations and it is the correlation with ozone variations on this time scale which will be described in this report. A comparison of SAGE I and II ozone profiles with "coincident" ozonesondes is also described.

SAGE II SHORT TERM OZONE/AEROSOL CORRELATIONS

SAGE II retrievals provide profiles of ozone concentrations and mixing ratios at local sunrises and sunsets at 1 km altitude intervals based on atmospheric absorption at 600 nm and neutral densities derived from temperature observations from the operational satellites of the National Weather Service (NWS). Aerosol extinctions are derived from the SAGE II data at several wavelengths. Here we use the extinctions at 1020 nm which are the least affected by Rayleigh scattering and absorption by the other gases being measured. Figure (1) shows the correlations between ozone concentrations and aerosol extinctions/km (typically proportional to aerosol concentrations) during each month from November 1984 to April 1990. The data analyzed includes only those profiles obtained between 45°N and 55°S and thus each monthly value is based on fewer than 100 profiles and a few days of observations per month. The correlations are predominantly positive below the aerosol maximum (not shown) but are negative above this maximum between 18 and 22 km. The correlations again become positive above 22 km altitude. It is important to also note that the correlations are large and seasonally variable with the largest correlations occurring in winter.

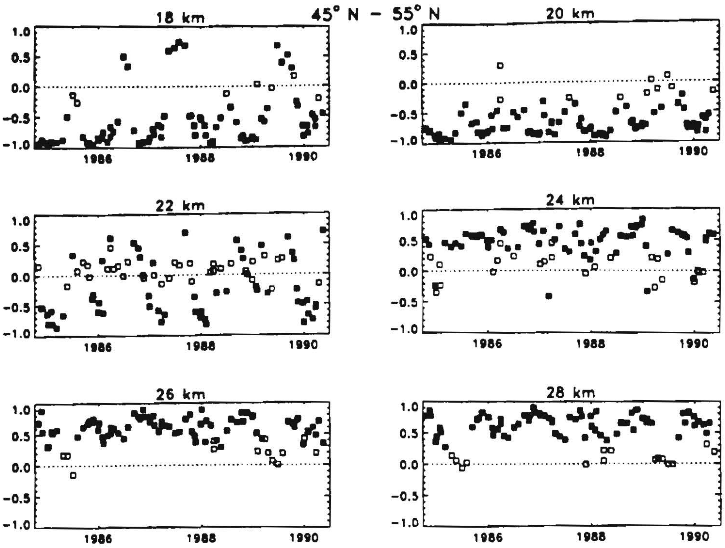

Fig. 1. The correlation between SAGE II ozone concentrations and 1020 nm aerosol extinction measurements over 1 month periods for the latitude range 45° to 55°N. Results are given at 2 km altitude intervals and the blackened squares indicate that the correlation coefficients are statistically significant.

The wintertime correlation coefficient maximum and the approximate coincidence of the positive to negative correlation coefficient transition with the aerosol concentration/mixing ratio maximum strongly suggests that the correlations are the result of atmospheric motions. For example, upward moving air parcels located below the aerosol peak would contain relatively small mixing ratios of both ozone and aerosols. However if this physical picture is correct, it is not obvious why the correlation reverses from negative to positive near the ozone concentration peak and several kilometers below the ozone mixing ratio peak. To explain this, it is necessary to consider both vertical and horizontal motions of air parcels and it is useful to employ a more transport conservative analysis procedure using mixing ratios on pressure surfaces.

Figure 2 shows the correlation coefficient and $R\sigma_1\sigma_2$ (where σ_1 and σ_2 are the standard deviations of ozone and aerosols) for SAGE II data for November 1984 determined after moving the data to pressure surfaces and dividing by air molecule concentrations. The pressure surfaces are numbered such that level i corresponds to a pressure of $1000 \times 2^{0.2(1-i)}$ mb. Thus the transition from negative to positive correlations occurs in this case at level 26.5 (approximately 30 mb and 24.5 km). Figure 3 shows the mean mixing ratio profile of ozone and the profile of the proxy for aerosol mixing ratio for the days of observation. Also shown are the local mean horizontal and vertical gradients plotted as vectors on a relative scale of 1000 vertically to 1 horizontally. Assuming that air parcels primarily undergo elliptical plane orbits in the meridional in the stratosphere (/3/), the correlated aerosol/ozone variations produced by advection can be expressed in terms of products of the zonal mean horizontal and vertical gradients of the constituents together with terms describing the amplitude of the ellipses and their tilt relative to the horizontal. From Figure 3 the transition at level 17.5 is associated with a reversal of the horizontal gradient in the aerosol mixing ratio; this is also very close to the location of the aerosol mixing ratio peak. The transition at level 26.5 is associated with a reversal of the horizontal gradient of the ozone mixing ratio. Thus provided that the ellipse tilt is less than 1 in 1000, a situation associated with quasi-horizontal mixing in the stratosphere, the correlation coefficient profile may be understood. An examination of the meridional distribution of stratospheric ozone indicates that the horizontal ozone gradient typically reverses between 20 and 40 mb (levels 29 and 34) at 50° latitude.

As further evidence of the importance of horizontal, meridional gradients, Figure 4 shows the levels of zero correlation between ozone and aerosol mixing ratios during the first year of SAGE II measurements (November 1984–November 1985). Also shown is the upper level at which $H_1H_2=0$. The mean level at which $H_1H_2=0$ and the mean zero correlation level are coincident but seasonal differences between the two levels suggest that the slope of meridional mixing surfaces undergo a seasonal cycle. Several more years of observation are however required to understand this cycle because not only does the ozone gradient vary from month to month, but there are also important variations in the aerosol gradient.

Most of the aerosol and ozone variations on a time scale of less than one month are thus produced by (primarily horizontal) advections of these constituents. The required magnitude of the stratospheric trajectories is of order 1 km vertically by 2000 km horizontally at 50° latitude. There is considerable information on atmospheric variability in the SAGE II ozone and aerosol records. However, the possibility of an underlying anomalous correlation large enough to affect SAGE II ozone trends in the lower stratosphere cannot yet be ruled out.

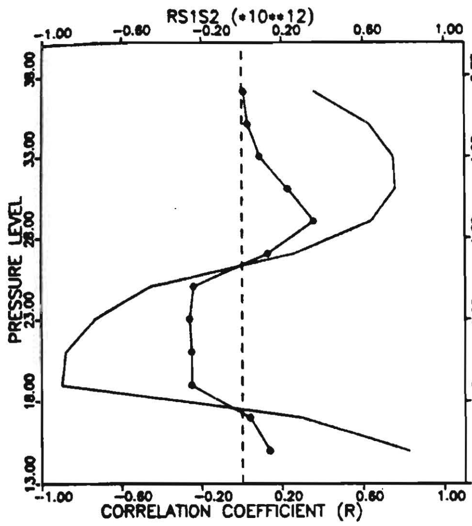

Fig. 2. The correlation coefficient (R) profile for SAGE II ozone mixing ratios and 1020 nm aerosol extinction divided by neutral density (m^{-3}) for November 1984 and measurements in the latitude range 50 ± 5°N after removal of the meridional gradients. Also shown is the product $R\sigma_1\sigma_2$ (line with dots).

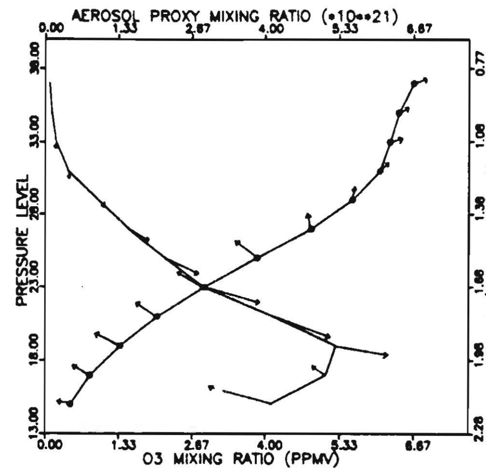

Fig. 3. The mean profiles of ozone mixing ratio (ppmv) and the proxy for aerosol mixing ratio for the conditions of Fig. 2. The meridional gradients at every other pressure level are indicated by the arrows on a scale of (1 km)$^{-1}$ vertically by (1000 km)$^{-1}$ horizontally. A leftward directed arrow indicates that the mixing ratio increases in the direction of the North Pole.

COMPARISON AGAINST OZONESONDES

An extensive comparison of SAGE I and II ozone profiles against both ECC and Brewer-Mast ozonesonde profiles has been conducted by R.E.V. This comparison has been made by interpolation of ozonesonde observations using NWS temperature profiles provided for each SAGE profile. The sonde data were uniformly reduced by 3% to conform to the currently accepted ozone cross-sections for Dobson column ozone measurements. Coincident colocation criteria were 0.5 days and 1000 km. Using the SAGE aerosol profiles, care was taken to identify and filter out low altitude ozone profiles which might be affected by clouds. Several representations of the data were tried in order to obtain a statistically normal distribution of the measurements but the results were not significantly different. Only those ozonesonde profiles with a total ozone correction factor of less than 15% were included in this comparison.

Figure 5 shows the comparisons grouped by latitude - with the southern hemisphere station at Lauder included in the "mid-latitude" data. Clearly there is better agreement between SAGE II and the ozonesondes than between SAGE I and the sondes below 20 km altitude. The latitude dependence of the SAGE-sonde differences are probably associated with the substantial increase of ozone mixing ratios with latitude which occurs in the lower stratosphere. The sudden change in the differences which occurs at approximately 15 km altitude is almost certainly associated with a change in the procedure used to infer the aerosol contribution to the 600 nm extinction. Above 14.5 km altitude the 385 nm channel is used in defining the aerosol extinction; below this altitude it is not used because of the large opacity at this wavelength. A contribution to the SAGE-sonde differences may also arise from the time-lag of the sonde measurement system during ascent through the large vertical ozone gradient characteristic of the lower stratosphere /4/.

Above 20 km altitude the SAGE-sonde differences are small and insignificant. It is thus useful to compare the SAGE-derived long term ozone trends above 20 km altitude against those inferred from the ozonesonde observations at Hohenpeissenberg and the combined data from Edmonton and Goose Bay. Figure 6 shows these results based on using all the profiles at these sites (not just the coincident profiles) during the period 1979-1989. The SAGE data used here consists of daily zonal means within a 10° wide latitude band centered at 48 and 53°N respectively. The trends expressed as differences over the 11 year period are shown in Figure 6. There is excellent agreement between the trends inferred from the SAGE and Canadian sonde observations and the SAGE and Hohenpeissenberg trends only differ at the 95% confidence level at 20.5 km altitude. These observations indicate that there has been a decrease in ozone between 20 and 25 km altitude of approximately 0.5%/year between 1979 and 1989, with the decrease being larger at the lower altitudes in this height range.

A decrease in ozone is also indicated below 20 km altitude; however because of the possible effect of aerosol on the SAGE ozone profile retrievals in this region, this result requires further validation. It is worth emphasizing that the relative aerosol contribution to the

SAGE ozone signal is more than two orders of magnitude smaller above 30 km altitude than at 15 km altitude and aerosols are therefore very unlikely to be contaminating SAGE ozone trends in the upper stratosphere. On the other hand, the different altitude registration procedures for SAGE I and SAGE II can result in systematic reference altitude differences within the stated uncertainties of approximately 0.2 km for each experiment.

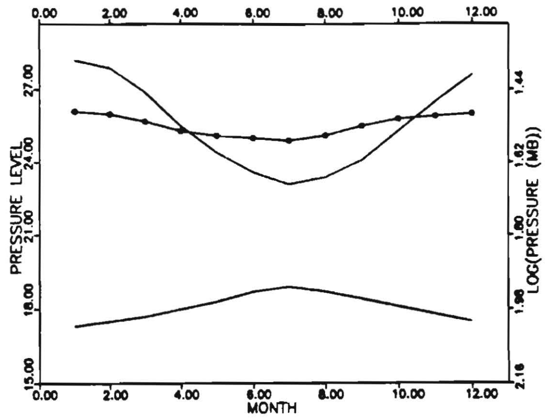

Fig. 4. The pressure levels at which there is zero correlation between SAGE II ozone and aerosol mixing ratios over the period November 1984 to August 1985. The seasonal cycle is derived from monthly analysis of profiles between 44 and 56°N and 44 and 56°S (plotted with a 6 month phase shift). Also shown is the seasonal cycle in the level where the product of the Northward gradients (H_1H_2) equals zero (line with dots; at the lower level this curve is indistinguishable from the zero correlation level curve).

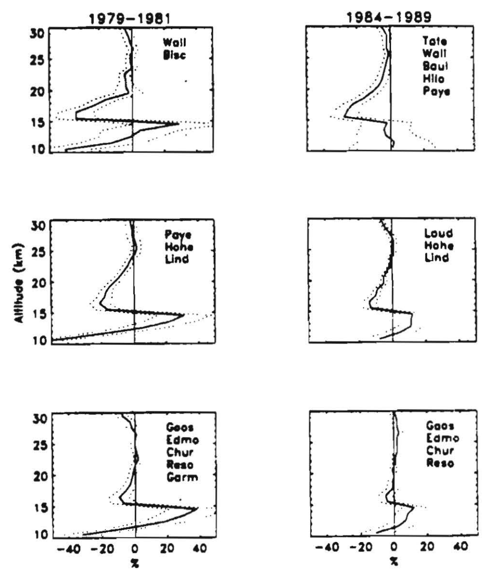

Fig. 5. (a) Ozonesonde - SAGE I mean differences relative to SAGE I, and (b) ozonesonde - SAGE II mean differences relative to SAGE II. The dashed lines represent 95% confidence intervals on the mean percentage difference.

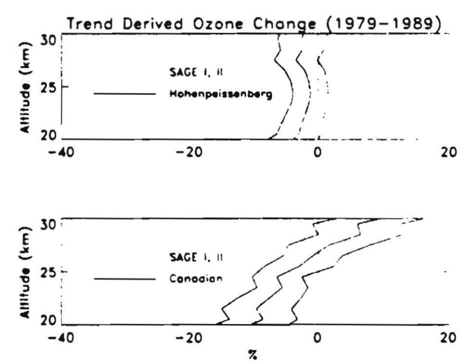

Fig. 6. Ozone trend estimates and 95% confidence limits computed using monthly averages of ozonesonde data (solid line) and combined SAGE I and SAGE II zonal means in a 10° latitude band (dashed line) over the period 1979-1989. (a) Hohenpeissenberg; (b) Combined Edmonton and Goose Bay data.

ACKNOWLEDGMENT

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MESOSPHERIC OZONE MEASUREMENTS BY SAGE II

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Abstract

SAGE II observations of ozone at sunrise and sunset (solar zenith angle = 90°) at approximately the same tropical latitude and on the same day exhibit larger concentrations at sunrise than at sunset between 55 and 65 km. Because of the rapid conversion between atomic oxygen and ozone, the onion-peeling scheme used in SAGE II retrievals, which is based on an assumption of constant ozone, is invalid. A one-dimensional photochemical model is used to simulate the diurnal variation of ozone particularly within the solar zenith angle of 80° - 100°. This model indicates that the retrieved SAGE II sunrise and sunset ozone values are both overestimated. The Chapman reactions produce an adequate simulation of the ozone sunrise/sunset ratio only below 60 km, while above 60 km this ratio is highly affected by the odd oxygen loss due to odd hydrogen reactions, particularly OH. The SAGE II ozone measurements are in excellent agreement with model results to which an onion peeling procedure is applied. The SAGE II ozone observations provide information on the mesospheric chemistry not only through the ozone profile averages but also from the sunrise/sunset ratio.

Introduction

The diurnal variation of ozone in the mesosphere has been discussed recently in several models such as Rusch and Liu (1981), Prather (1981) and Allen et al (1984). They all display a similar pattern for the ozone diurnal variations, however none of them have compared model results and measurements in the transition period such as at sunrise and sunset because of the lack of observations. SAGE II ozone measurements are however made at 90° solar zenith angle and thus provide an excellent opportunity to examine the behavior of ozone at sunrise and sunset, or more particularly the variation between sunrise and sunset (i.e. the ozone sunrise/sunset ratio), and thus to test mesospheric ozone photochemistry.

The SAGE II data we examined are for the five-year period, 1985-1990. The vertical resolution of the ozone observations is approximately 1 km. The SAGE II ozone channel is centered at 0.6 μm in the Chappuis band. The orbital period is approximately 1.5 hours which results in 30 events per day (15 sunrises and 15 sunsets). The separation of each sunrise or sunset event is approximately 24 degrees in longitude and less than one half a degree in latitude. Each retrieved ozone profile is approximately representative of the atmosphere at local sunrise or sunset but it is derived on the basis of the assumption that temporal ozone variation is not included.

A one-dimensional photochemical model is utilized to investigate the ozone variation during twilight hours. Although transport effects might be important on time scales of an hour or more the resulting ozone changes are equally as likely to be positive or negative in the tropics and should thus be averaged out over many observations. Two types of chemical schemes were used to study the ozone diurnal variation : pure oxygen photochemistry and the photochemistry involving both odd oxygen and odd hydrogen.

The model simulations clearly show unequal sunrise and sunset ozone profiles (i.e. sunrise > sunset) at altitudes between 55 and 65 km. The SAGE II ozone profiles had also shown the differences between sunrise and sunset at that altitude range. Above 65 km the SAGE II retrieved ozone concentrations are controlled by retrieval constraints because of measurement noise (Cunnold et al, 1989; Chu et al 1989). The differences between sunrise and sunset of SAGE II ozone are found to be much larger than those modeled at 90° solar zenith angle. This paper emphasizes the ozone sunrise/sunset ratio rather than the individual sunrise or sunset profiles in order to test our understanding of mesospheric ozone chemistry during twilight and nighttime hours.

One-dimensional, time-dependent model

As already indicated above the modeling effort is focused on the behavior of ozone between sunset and sunrise. The overnight loss of odd oxygen caused by reactions between atomic oxygen and odd hydrogen radicals is included. Odd hydrogen concentrations in the mesosphere are poorly known. The twilight behavior of odd hydrogen species is therefore modeled. We have not however attempted to simulate the full diurnal cycle of ozone because this would introduce additional modeling uncertainties and SAGE II provides no information on daylight ozone concentrations in the mesosphere.

The geometry of the model is displayed in Figure 1. The chemical species abundance is a function of solar zenith angle and altitude. The coverage of the model is from 50 to 80 km and from 80° to 120° solar zenith angle. Photochemical reactions used in the model are tabulated in Table 1. Photochemical equilibrium of ozone is assumed at 80° solar zenith angle and the ozone first guess values are from the U.S. Standard Atmosphere (1976). The model time step is set equal to 2 seconds to accommodate the fast chemical time scale of atomic oxygen variations at 50 km altitude (i.e. 10 seconds). The height increment is 0.5 km which is one-half of the SAGE II vertical resolution.

In order to obtain the initial slant path ozone abundances, which are needed to compute the photodissociation rate of ozone, a Chapman function (Smith and Smith, 1972) is employed at the upper boundary (= 80 km) and at the initial state as well (i.e. = 80° solar zenith angle). Elsewhere linear interpolation is applied to the ozone concentrations at the nearest intersection of the altitude and solar zenith angle grid. The absorption cross section of ozone and solar irradiances are from Atmospheric Ozone (1985), and the cross sections of molecular oxygen in Schumann-Runge bands are from Frederick and Hudson (1980).

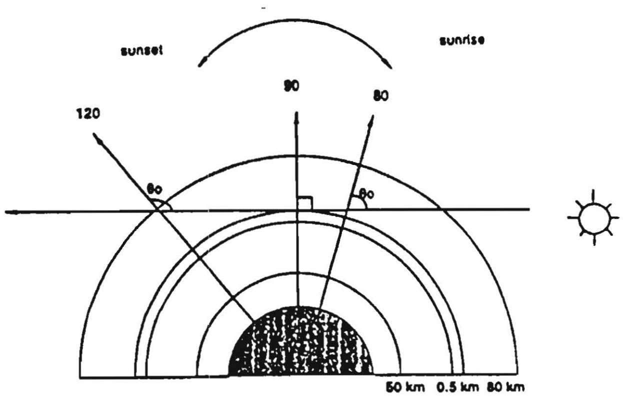

Fig.1 Model geometry used to calculate columnar ozone amounts and photodissociation rates. θ_0 indicates the local solar zenith angle of incremental contributions.

The integration procedure at sunset is straightforward and requires no iteration. Due to the model geometry (see Figure 1) the ozone column along the sunset ray contains contributions from different solar zenith angles (i.e. earlier local times for which calculations have been completed). For the sunrise ray, on the other hand, the grid points correspond to later times for which the calculations have not yet been made. To obtain the ozone profile at sunrise, the model was thus integrated starting from the nighttime ozone values until the convergence is attained. In each iteration the updated slant path columns produce updated ozone profiles. The model seeks convergence at each altitude and solar zenith angle grid point. Six iterations are typically required using a factor of 0.0001 times the ozone concentration as the convergence criterion at each grid point.

It is assumed in these calculations that ozone absorption is much larger than the effect of Rayleigh scattering. Anderson (1983) pointed out that the multiple scattering of solar radiation can be ignored at altitudes above 50 km at wavelengths less than 0.31 μm. Although it can become important at large solar zenith angles (> 93-94) (Noxon et al, 1979), the substantial absorption by ozone at these angles results in negligible photodissociations below 70 km altitude. At lower altitudes where the reflection of solar radiation may be strong it can also be ignored compared to the absorption by ozone. The effect due to multiple scattering and ground albedo is thus neglected, however, the singly scattered solar radiation from an infinitesimally thin layer (Solomon et al (1987)) is included.

Because of the sensitivity of the calculations to the initial ozone profile, it is important that the calculated sunrise/sunset ratio is constrained by the observed ozone profile. The initial ozone profile is therefore iterated until the calculations yield the observed ozone profile (1% difference is assumed) at sunset. It should be noted that the agreement between the calculated profile and the observed SAGE II mean profile is obtained only after the onion peel inversion procedure has been applied to the calculated time-dependent profiles.

HO_x-O_x photochemistry

Odd hydrogen compounds contribute to an overnight loss of odd oxygen through the following reactions

$$O + OH \rightarrow H + O_2$$

$$H + O_2 + M \rightarrow HO_2 + M$$

$$O + HO_2 \rightarrow OH + O_2$$

Table 1 Photochemical reactions used in the model

	Reactions	Rate constants
(R1)	$O_3 + h\nu \rightarrow O + O_2$	$\lambda < 0.31\ \mu m$
(R2)	$O + O_2 + M \rightarrow O_3 + M$	$6.0 \times 10^{-34} (300/T)^{2.3}$
(R3)	$O + OH \rightarrow H + O_2$	$2.3 \times 10^{-11} \exp^{-90/T}$
(R4)	$O + HO_2 \rightarrow OH + O_2$	$2.8 \times 10^{-11} \exp^{172/T}$
(R5)	$H + O_2 + M \rightarrow HO_2 + M$	$1.76 \times 10^{-28} T^{-1.4}$
(R6)	$OH + HO_2 \rightarrow H_2O + O_2$	8.4×10^{-11}
(R7)	$OH + OH \rightarrow H_2O + O$	$4.5 \times 10^{-12} \exp^{-275/T}$
(R8)	$HO_2 + HO_2 \rightarrow H_2O_2 + O_2$	$2.4 \times 10^{-14} \exp^{1250/T}$
(R9)	$O + O_3 \rightarrow 2O_2$	$1.5 \times 10^{-11} \exp^{-2218/T}$
(R10)	$O_2 + h\nu \rightarrow O + O$	$0.17 < \lambda < 0.25\ \mu m$
(R11)	$H + O_3 \rightarrow OH + O_2$	$1.4 \times 10^{-10} \exp^{-270/T}$
(R12)	$OH + O_3 \rightarrow HO_2 + O_2$	$1.6 \times 10^{-12} \exp^{-940/T}$

The reaction constants are all from Allen et al, 1984 except (R2) (which is from J. Phys. Chem., Vol. 11, 1982), photodissociation rates of ozone and molecular oxygen are calculated in the model itself.

which encompass a major catalytic destruction of odd oxygen above the stratopause. The OH abundances taken from Allen et al (1984) around 1800 hr are used as initial values. The HO_2 is derived in the photochemical balance as follows

$$[HO_2] \approx \frac{K_3}{K_4}[OH] - \frac{K_{11}[H][O_3]}{K_4[O]}$$

These catalytic reactions are able to destroy atomic oxygen very efficiently and when the abundance of atomic oxygen is greater than 10^7 cm^{-3} (~ 1/400 of its daytime value) a significant loss of O_x is thus expected. The equation controlling the loss of odd oxygen in this model can be written as

$$\frac{\partial[O_x]}{\partial t} = 2 J_{O_2}[O_2] - 2 K_3 [O][OH] - 2 K_9 [O][O_3]$$

Figure 2 depicts the variability of odd oxygen from 80° to 110° solar zenith angle between 50 and 70 km. At 70 km, approximately 35% of the initial odd oxygen is destroyed within a two hour period around sunset. A 15% loss of odd oxygen occurs before sunset and a 20% loss takes place after dark. During the period before sunset the O/O_3 ratio remains constant, with O of an order of magnitude larger than O_3. In the early part of night during which the O/O_3 ratio decreases by a factor of two, no significant increase of ozone occurs. This is because oxygen atoms are removed by O+OH catalytic reactions instead of being converted to O_3. At solar zenith angles greater than 93° (at which time O has decreased to just a factor of two larger than O_3), ozone begins to increase substantially. At 65 km altitude, the odd oxygen loss is primarily concentrated in a hour period before sunset, and the loss of odd oxygen is approximately 30%. The O/O_3 ratio however, in the same period, tends to remain a constant. At 60 km the loss of odd oxygen is 15% and only occurs before sunset. Below 60 km the loss of odd oxygen is small - only 5% at 55 km and 2% at 50 km.

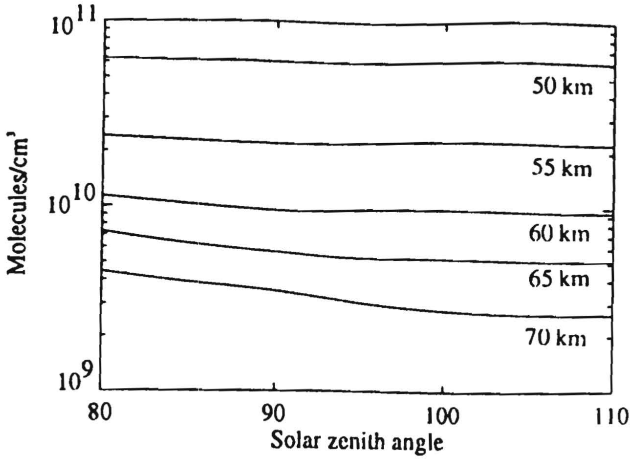

Fig. 2 The calculated variation of odd oxygen of HO_x-O_x chemistry at sunset between 80° and 110° solar zenith angle from 50 to 70 km altitude.

Table 2 Selected days of SAGE II ozone observations

	sunrise	sunset
Nov 6	21.3° N	21.3° N
Jan 16 & 17	17.5° N	17.1° N
May 6 & 7	20.7° S	21.5° S
July 18	17.0° S	17.8° S

Figures 3(a) and 3(b) show the variation of ozone between 80° and 110° solar zenith angles during sunset and sunrise, respectively. The modeled ozone variations for both sunset and sunrise show good agreement with Allen et al (1984).

OH oscillates up and down within the two-hour period around sunset at 70 km. Figure 4 illustrates the OH variations with solar zenith angle. The variations of HO_2 (not shown) are photochemically coupled with OH. The variations of OH are less important during the period before sunrise (not shown) than in the period after sunset not only because OH concentrations are approximately an order magnitude smaller but also because the abundances of atomic oxygen are small. Therefore the destruction of O_x due to HO_x is not effective just before sunrise, and only the conversion of ozone to atomic oxygen needs to be considered in this period.

The photodissociation of water vapor is not included in the model because (1) the photodissociation of H_2O is quite small at twilight in the mesosphere and (2) there is no direct impact on O_3 due to H_2O. In addition, SAGE II does not measure H_2O above the stratosphere. Furthermore, we would like to keep the photochemical reaction set as simple as possible in order to better understand the photochemistry in the mesosphere. The results indicates that at 70 km a 5% OH change will induce a 1% change in O_3. The one hour average of J_{H_2O} before sunset contributes approximately 5% increase in OH. Therefore 1% ozone change is expected. But this can be neglected compared to SAGE II measurement uncertainty.

The comparisons of model results and SAGE II ozone measurements

Because of seasonal and latitudinal variations in the ozone diurnal changes, the selection of SAGE II measurements used in the comparison becomes significant. In one year of SAGE II data, only five days (four days in tropical region and one at mid-latitude) have been found where sunrise and sunset events are within one degree of latitude difference in a 24 hour period. Table 2 exhibits selected profiles when the average zonal mean

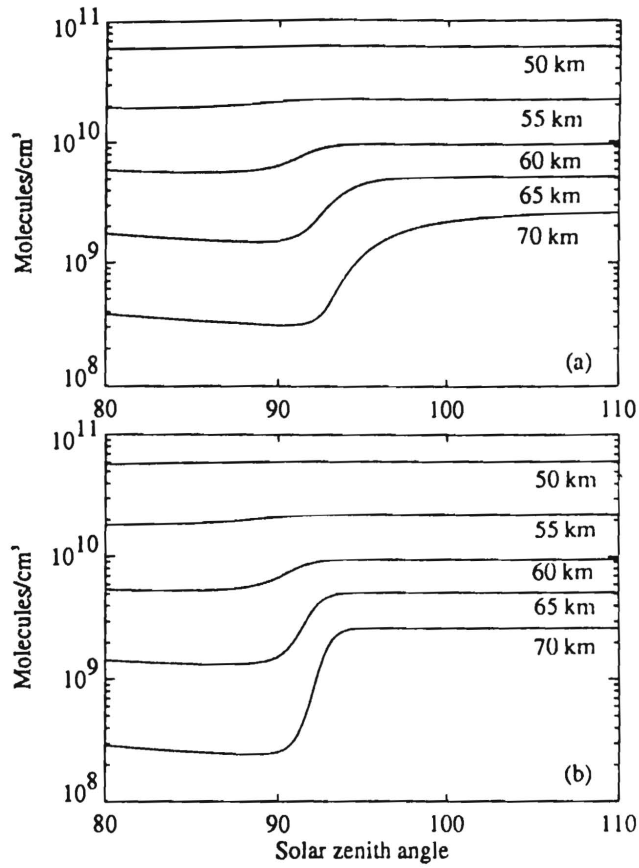

Fig. 3 (a) The calculated variation of ozone of HO_x-O_x chemistry at sunset between 80° and 110° solar zenith angle from 50 to 70 km altitude.(b) same as (a) except at sunrise.

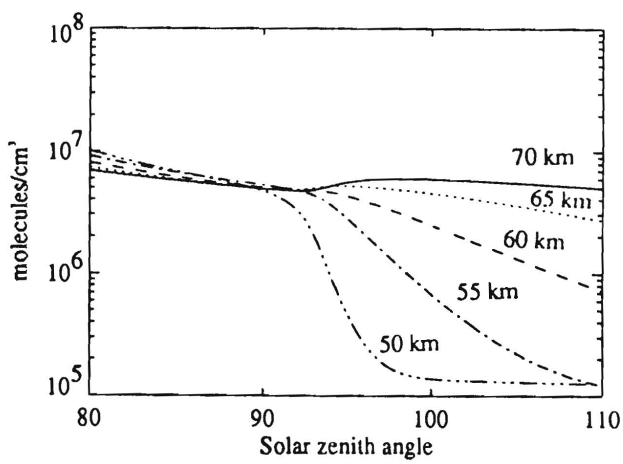

Fig. 4 The calculated variation of OH of HO_x-O_x chemistry at sunset between 80° and 110° solar zenith angle from 50 to 70 km altitude.

latitudes of sunrise and sunset events are within 1 degree of each other. In this comparison, only SAGE II zonal mean values are used. The longitudinal variation of the ozone measurements is affected by random noise (Cunnold et al, 1984 and 1989) particularly in the tropical region - where most of the sunrise and sunset coincidences occur.

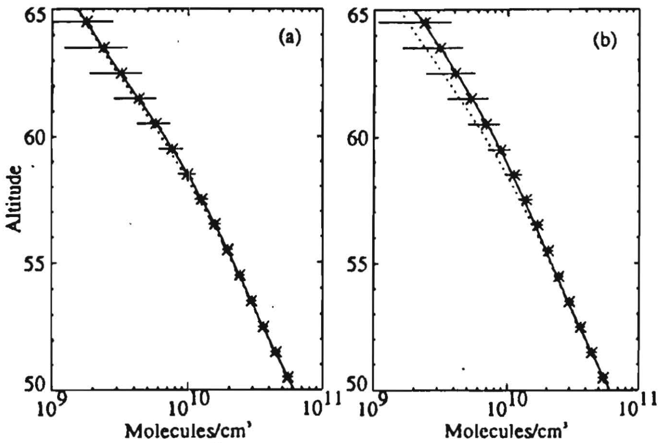

Fig. 5 (a) The comparisons of ozone profiles on the selected days between 50 and 65 km at sunset; star with error bar : SAGE II ozone profile; solid line : retrieved ozone profile of model results; dotted line : ozone profile at 90° solar zenith angle of model results. (b) same as (a) except at sunrise.

Within the four tropical zonal means, it is found that the model results display nearly identical ozone variations both at sunrise and sunset. Therefore the ensemble mean of the zonal average of the four coincident events (per year) can be used to compare with the model predictions. Figures 5(a) and 5(b) shows the means (star) and standard deviations (shown as error bars) of the twenty events at both sunrise and sunset of the selected days over the five-year SAGE II data set. In the calculations reported here SAGE II sunset profiles have been used as a constraint on the ozone near 90° solar zenith angle.

An onion-peeling algorithm applied to slant column inferred from the model results begins at 78 km (ozone at 78 km is guessed initially). The ozone concentration is estimated by subtracting the sum of the ozone concentrations weighted by the path length in all higher altitude layers from the slant column content. In the onion peeling inversion, homogeneous spherical shells with constant ozone concentrations are assumed. This procedure produces a hypothetical ozone profile inferred from the model calculations which may be directly compared against retrieved SAGE II ozone profiles.

For pure oxygen chemistry the modeled and observed sunrise/sunset ratio agrees well only at the altitudes between 50 and 60 km. Overestimates of the ratio are found above 60 km with a maximum of 30% at 63 km. The overestimation is totally attributable to the excess of oxygen atoms above 60 km in the model at sunset, which then produce excessive nighttime ozone concentration. Consequently an excessively large and asymmetric ozone variation is produced at sunrise. Because the asymmetry will propagate downward via the onion peel procedure, the more asymmetric the variation about 90° the deeper the effect will penetrate.

When the chemistry of odd oxygen and odd hydrogen is included, fewer oxygen atoms are available to be converted into ozone and therefore there is a tendency for an increase in the ozone photodissociation rate. At 70 km, the transition from O to O_3 is thus deferred at sunset, and an earlier transition occurs oppositely at sunrise. The time difference corresponds to approximately one degree solar zenith angle. At lower altitudes because of the smaller ozone diurnal variation the effect is less pronounced.

Figures 5(a) and 5(b) have also displayed the simulated ozone (i.e. the solid lines) after the onion-peeling retrieval method has been applied. The agreement between SAGE II ozone means and modeled ozone is within 1% at sunset and better than 5% at sunrise. We consider these difference to be small compared to the measurement uncertainties of SAGE II. Furthermore, the photochemical reactions used in the model, disregarding the photodissociation of water vapor, are sufficient to describe sunset and sunrise ozone variations in the altitudes from 50 to 65 km.

Table 3 Correction factors of SAGE II ozone profiles at sunrise and sunset in the tropics

km	65	64	63	62	61	60	59	58	57	56	55
sr	1.29	1.30	1.29	1.26	1.21	1.16	1.12	1.09	1.06	1.03	1.03
ss	1.03	1.04	1.05	1.06	1.07	1.07	1.07	1.06	1.06	1.04	1.03

sr : sunrise; ss : sunset

Also, in Figures 5(a) and 5(b) the ozone values at 90° solar zenith angle are shown as dotted line. According to the ozone profiles at 90° solar zenith angle and the simulated ozone profile (at which the onion-peeling method has been applied), we can infer the correction factors for the SAGE II ozone measurements. Table 3 shows the correction factors between 55 and 65 km. Below 55 km only 1% corrections are needed.

Acknowledgements

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5. Comparison of SAGE II ozone against UARS data

SAGE II ozone profiles were compared against MLS, CLAES (blocker 8 and blocker 9) and ISAMS measurements over the periods: January 9-11 (45 UARS nighttime profiles between 5S and 10N, and 45 UARS daytime profiles at 21-34N), April 15-17 (42 UARS nighttime profiles at 22-36N), and for January 9 separately using the new "TEST" ISAMS data. Comparisons were also made for August 25-28 (56 UARS daytime profiles at 44-53S) with CLAES data being unavailable for August 27 and ISAMS not operating throughout the period, for April 18-20 (45 UARS nighttime profiles at 5-22N, and 44 UARS nighttime profiles at 3-29N). The time differences between the SAGE II and the UARS measurements varied between 0 and 7 hours (averaging 3 hours) and the spatial colocation differences varied within each comparison period over the range 0 to 14 degrees longitude (averaging ~7 degrees) and 0 to 2 degrees in latitude (average ~1 degree). Data was only utilized if the error bars for the two instruments being compared were less than 50% of the measured ozone mixing ratios. The SAGE II profiles were all smoothed over the altitude range of ~2.5 km between UARS pressure levels.

Figure 5.2.1.5-1 shows the mean differences of the UARS ozone measurements from the SAGE II measurements over the period January 9-11 between 21 and 34N. The standard errors in the differences are seen to be small (typically < 0.2 ppmv). MLS and ISAMS show differences of less than ~0.5 ppm except below 5 mb where the ISAMS (V0006) measurements are known to be contaminated by aerosols and at 46 mb for MLS where the SAGE II measurements are lacking precision also because of aerosol effects. The CLAES (B9 differences) possess a strongly varying structure with altitude with minima at 0.68, 3.2 and 14.7 mb. Figure 5.2.1.5-2 shows a similar comparison for January 9 but using the "TEST" ISAMS algorithm; it suggests that this revised algorithm has been successful in removing much of the aerosol contamination.

Figures 5.2.1.5-3 and -4 compares standard deviations of the UARS-SAGE II differences over the January 9-11 period to the means of the error bars provided with each profile. Of the intercomparison periods analyzed, only this period (at these latitudes) and the August 25-28 period showed covariances (i.e. stratospheric variability?) exceeding 1% of the product of the ozone measurements, and even then only near 1 and 10 mb. The vertical structure of the MLS/SAGE II correlation reflects this with a minimum being exhibited near 3 mb; this is consistent with our understanding of vertical differences in the variability of atmospheric ozone. If the error bars are realistic, the standard deviations of the UARS-SAGE II differences should be equal, in a statistical sense, to the square root of the sum of the square of the errors. It should be noted, however, that the SAGE II error bars need to be reduced by a factor of ~1.2 for the smoothing of the SAGE II profiles to the UARS levels. A good consistency is then shown in this MLS/SAGE II comparison between 10 and 0.46 mb. Note that there exists little correlation of SAGE II and MLS at 0.46 mb almost certainly because the errors substantially exceed atmospheric variability in this period at this level. While the SAGE II error bars appear to be somewhat too large below 10 mb, the MLS/SAGE II correlation becomes small in this region almost certainly because of SAGE II errors introduced by aerosol effects.

Figure 5.2.1.5-3 also shows that for ISAMS there is significant correlation with the SAGE II measurements between 2.2 and 0.32 mb and that the ISAMS error bars may be slightly too large above 1 mb. The strong correlation at 10 mb suggests that the aerosol effects on the ISAMS profiles, at least in this case, may be fairly systematic. The CLAES (B9) results show that the altitudes where B9 ozone values are small, correspond to large error bars and maximum variability in CLAES (B9)/SAGE II differences. The CLAES (B9) error bars appear to be a factor of ~2 too large (perhaps corresponding to the inclusion of some systematic errors). For CLAES (B8), the standard deviations of the CLAES (B8)/SAGE II differences are no worse than for B9, indicating that the differences between CLAES (B8) and SAGE II are dominated by systematic errors. The error bars given for CLAES (B8) are larger than for B9, probably because of the inclusion of some of these larger systematic errors in blocker 8.

The results shown in Figures 5.2.1.5-1 and 5.2.1.5-2 are typical of the intercomparisons. Figures 5.2.1.5-5 and -6 shows the means and standard deviations of the intercomparison period differences (each period receiving equal weight). The standard deviations shown are similar to the instrumental error bars, indicating that the measurement differences are a function of latitude and/or season (perhaps in part because of variations in temperature structure and aerosol loading). Although most of the UARS observations used in these comparisons were nighttime measurements, because of variations in the measured differences, obvious differences between the nighttime and the daytime intercomparisons were not apparent. Of the intercomparison periods considered, the January 9-11 period near the equator (SAGE II sunrises) exhibits the largest differences between the SAGE II and the UARS instruments, almost certainly because of the exceptionally large aerosol loading at this time (and the effects of aerosols on the SAGE II and the infrared sensors almost certainly extends considerably above 10 mb in this case).

The mean differences between SAGE II and the other instruments (over the latitude range 0-55 degrees) show MLS approximately 3% larger than SAGE II between 1.5 and 10 mb and smaller than SAGE II outside this range. ISAMS ozone profiles possess a steeper vertical gradient than SAGE II with the current ISAMS algorithm being known to be influenced by aerosols near 10 mb and with ISAMS concentrations ~15% smaller near 1 mb. The CLAES (B9) mean differences exhibit the strongly banded structure seen in the January intercomparison although somewhat smoothed in altitude. Ozone is being significantly underestimated by CLAES (B9) near 1 and 10 mb.

Combining the standard deviations shown in Figures 5.2.1.5-5 and -6 with the "typical" random errors inferred from the standard deviations of the differences given in Figures 5.2.1.5-3 and -4, a self-consistent set of profile repeatability values for each instrument are shown in Table 1. This table also shows biases with respect to SAGE II obtained by taking means and standard deviations of the altitudinal differences shown in Figures 5.2.1.5-5 and -6. We conclude that the accuracy and precisions are approximately 5% for MLS, 10% for ISAMS (where aerosol contamination effects are small) and 15% for CLAES (B9). Note that if the biases can be removed from the CLAES (B8) values, they have the potential to provide ozone values to 10% precision. The accuracies and precisions listed may extend to altitudes below 32 mb, for MLS in particular, but it is not possible to conclude this from these intercomparisons because of potentially significant aerosol-related errors in the SAGE II profiles at low altitudes during this intercomparison period.

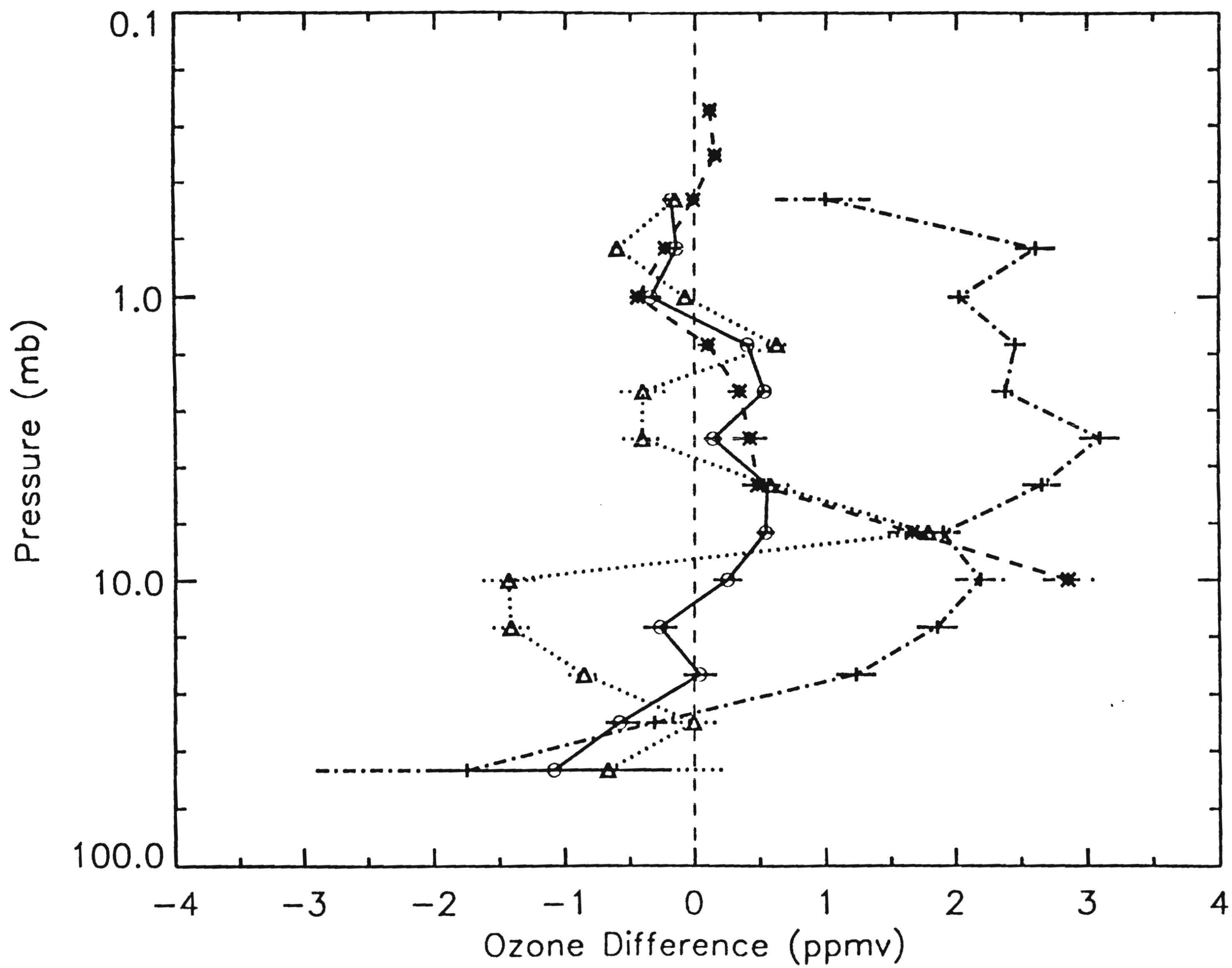
Table 1. Instrumental repeatability of UARS ozone measurements inferred from differences with SAGE II measurements between 0 and 55 latitude over data intercomparison periods between January and August 1992. Also shown are mean and standard deviations of the mean altitudinal differences.

Instrument	Repeat-ability	Pressure Range	Bias with respect to SAGE II	Pressure Range
MLS	> 5%	1.5 - 15 mb	0 +/- 5%	0.46 - 32 mb
ISAMS	> 10%	0.46 - 5 mb	-5 +/- 7%	0.32 - 7 mb
CLAES (B9)	> 15%	0.46 - 32 mb	-7 +/- 8%	0.46 - 32 mb
CLAES (B8)	> 10%	1 - 21 mb	23 +/- 5%	2 - 21 mb
SAGE II	> 5%	0.46 - 10 mb	accuracy approx. 5%	0.32 - 10 mb

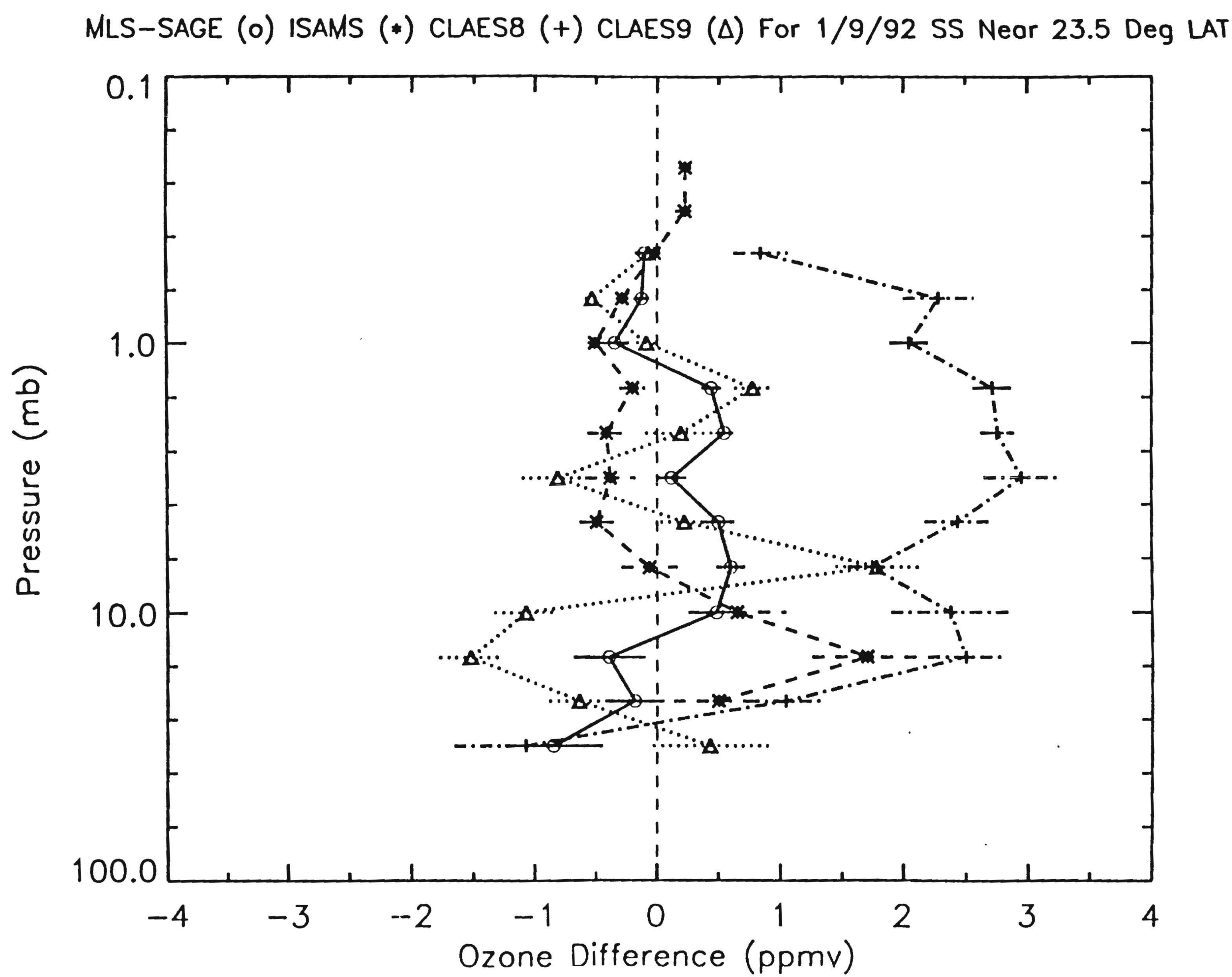
One comparison has been made between HALOE and SAGE II consisting of 15 profiles on May 6 at 50S (Figure 5.2.1.5-7). HALOE mixing ratios are 5-10% larger than SAGE II between 1.5 and 32 mb. There is agreement within approximately 5% between 1 and 0.46 mb. At latitudes above 0.46 mb, HALOE values are ~30% larger than SAGE II. Rms differences are approximately 10% at all altitudes when the mean differences are removed. These differences are illustrated in Figure 5.2.1.5-8, where they are shown as a function of longitude.

6. Balloon Comparisons

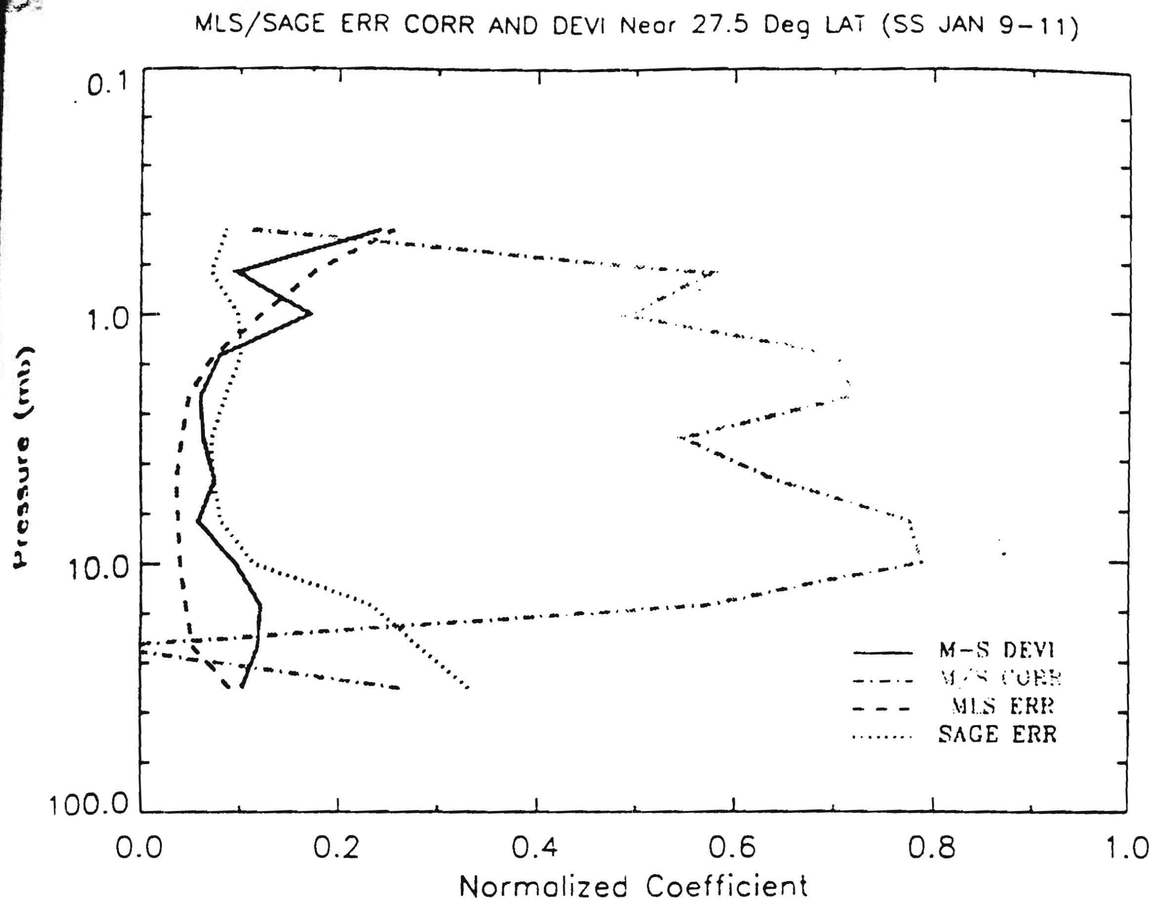
MLS-SAGE (o) ISAMS (*) CLAES8 (+) CLAES9 (Δ) For Jan 9-11 SS Near 27.5 Deg LAT

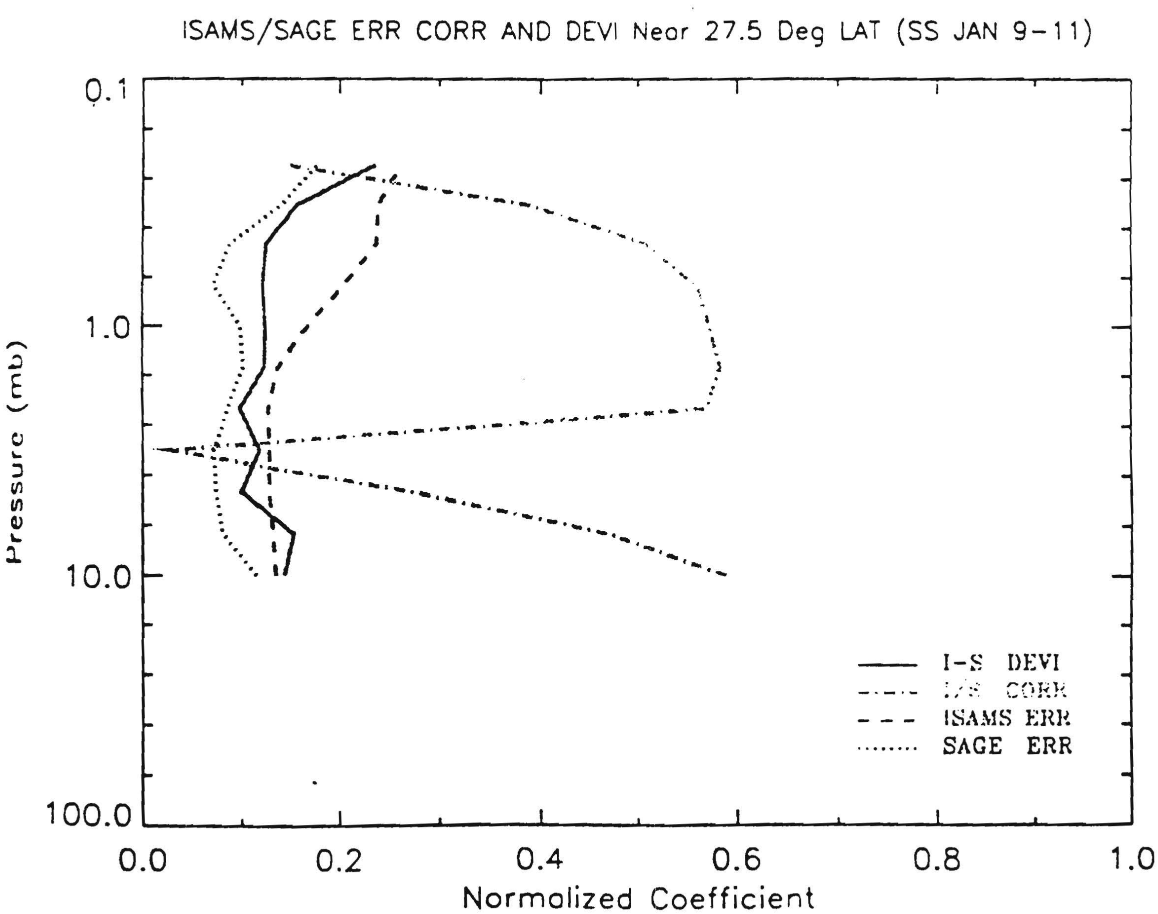


5.2.1.5-1


MLS-SAGE (o) ISAMS (*) CLAES8 (+) CLAES9 (Δ) For 1/9/92 SS Near 23.5 Deg LAT
Pressure (mb)
0.1
1.0
10.0
100.0
−4
−3
−2
−1
0
1
2
3
4
Ozone Difference (ppmv)

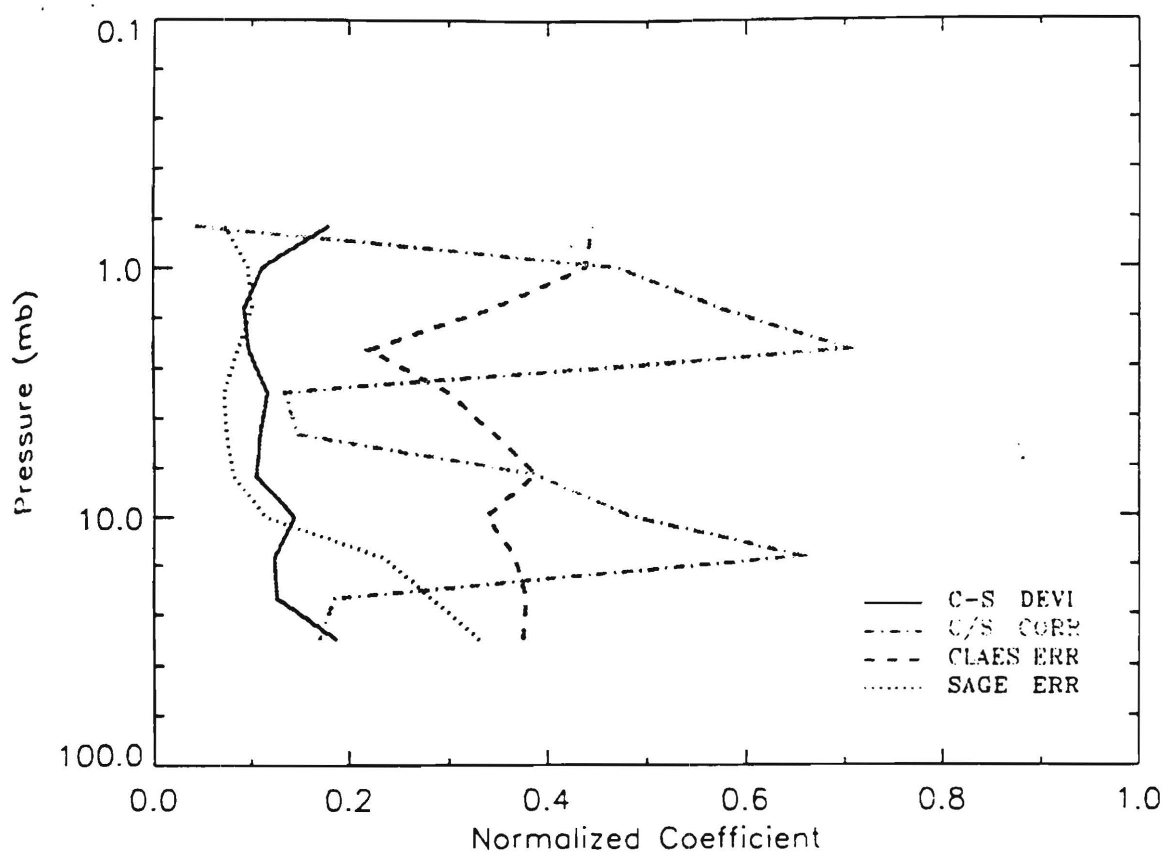
5.2.1.5-2


MLS/SAGE ERR CORR AND DEVI Near 27.5 Deg LAT (SS JAN 9-11)
0.1
1.0
10.0
100.0
Pressure (mb)
0.0
0.2
0.4
0.6
0.8
1.0
Normalized Coefficient
M-S DEVI
M/S CORR
MLS ERR
SAGE ERR

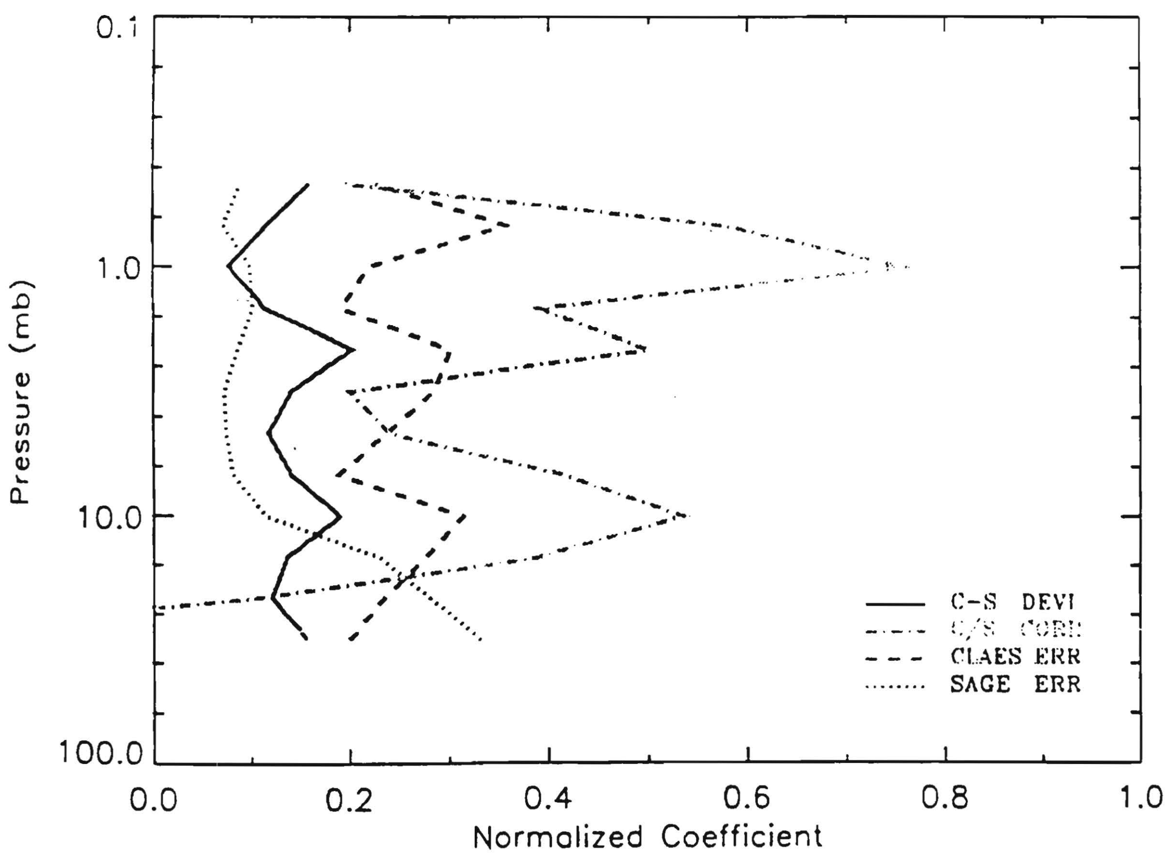

ISAMS/SAGE ERR CORR AND DEVI Near 27.5 Deg LAT (SS JAN 9-11)
0.1
1.0
10.0
100.0
Pressure (mb)
0.0
0.2
0.4
0.6
0.8
1.0
Normalized Coefficient
I-S DEVI
I/S CORR
ISAMS ERR
SAGE ERR

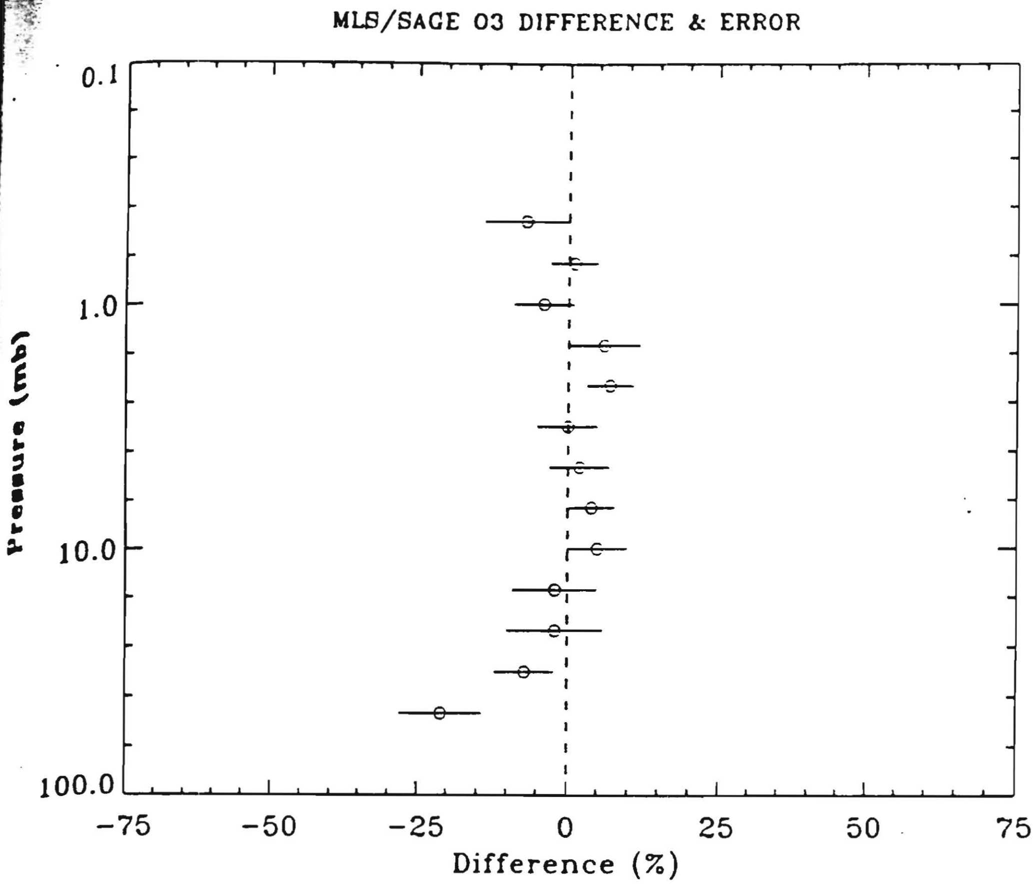
21-5-3

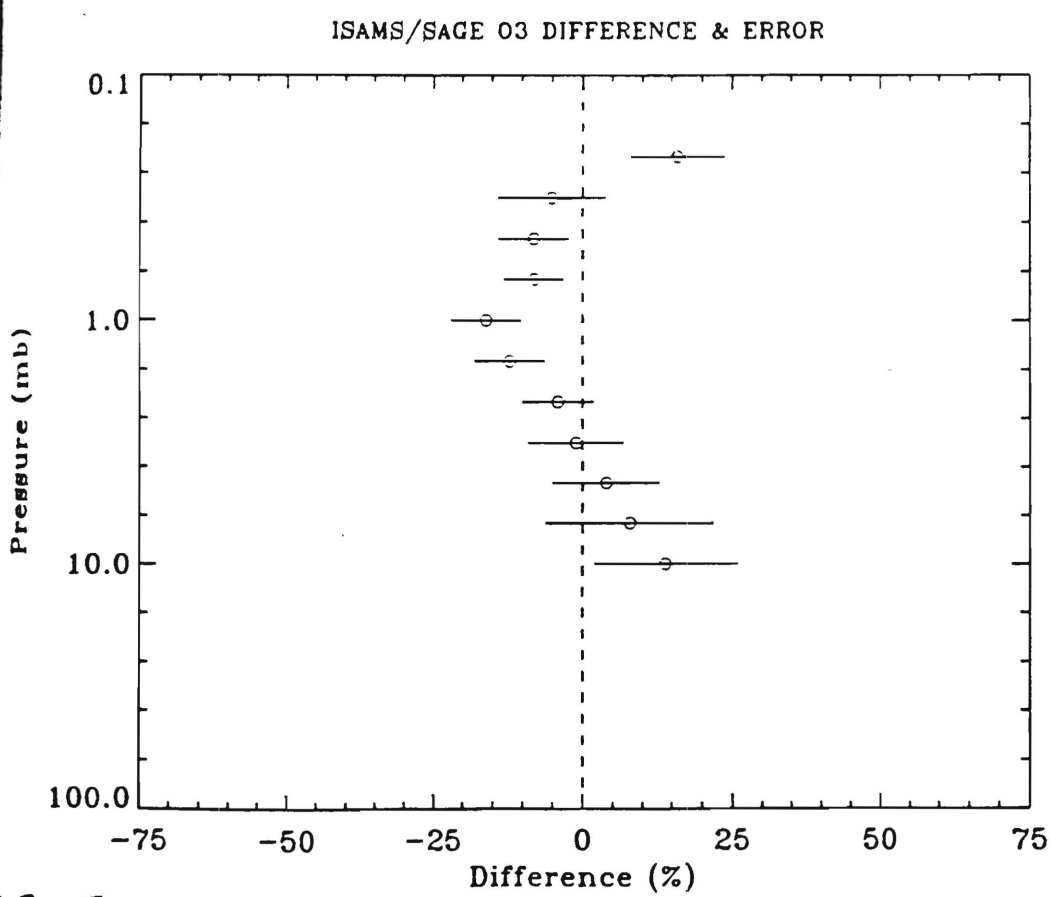
CLAES-8/SAGE ERR CORR AND DEVI Near 27.5 Deg LAT (SS JAN 9-11)



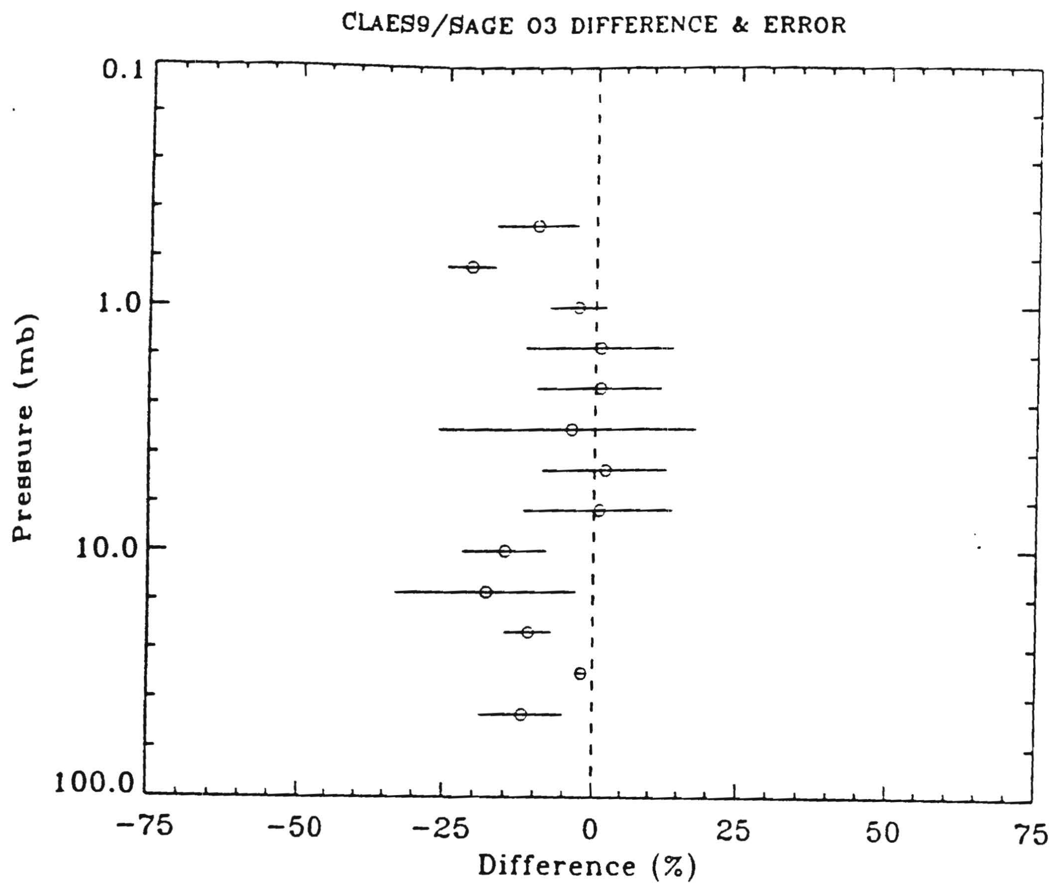
CLAES-9/SAGE ERR CORR AND DEVI Near 27.5 Deg LAT (SS JAN 9-11)

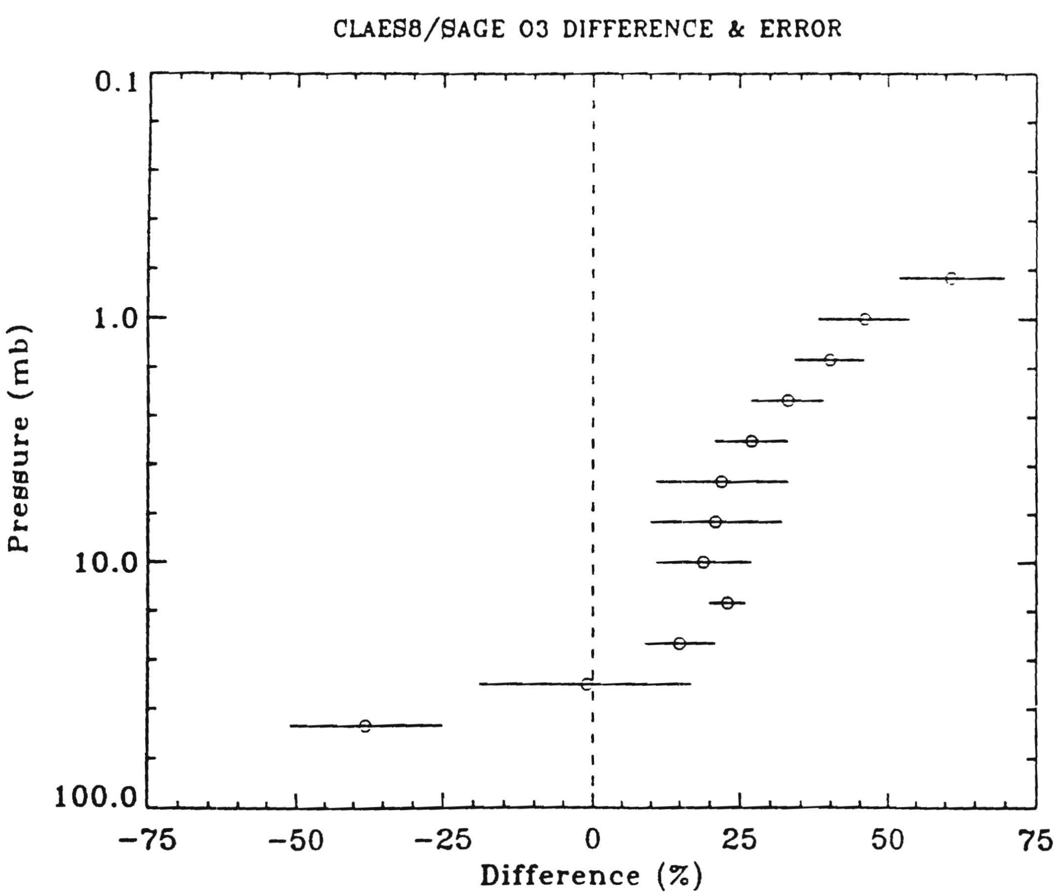



MLS/SAGE O3 DIFFERENCE & ERROR
0.1
1.0
10.0
100.0
Pressure (mb)
-75
-50
-25
0
25
50
75
Difference (%)


ISAMS/SAGE O3 DIFFERENCE & ERROR
0.1
1.0
10.0
100.0
Pressure (mb)
-75
-50
-25
0
25
50
75
Difference (%)

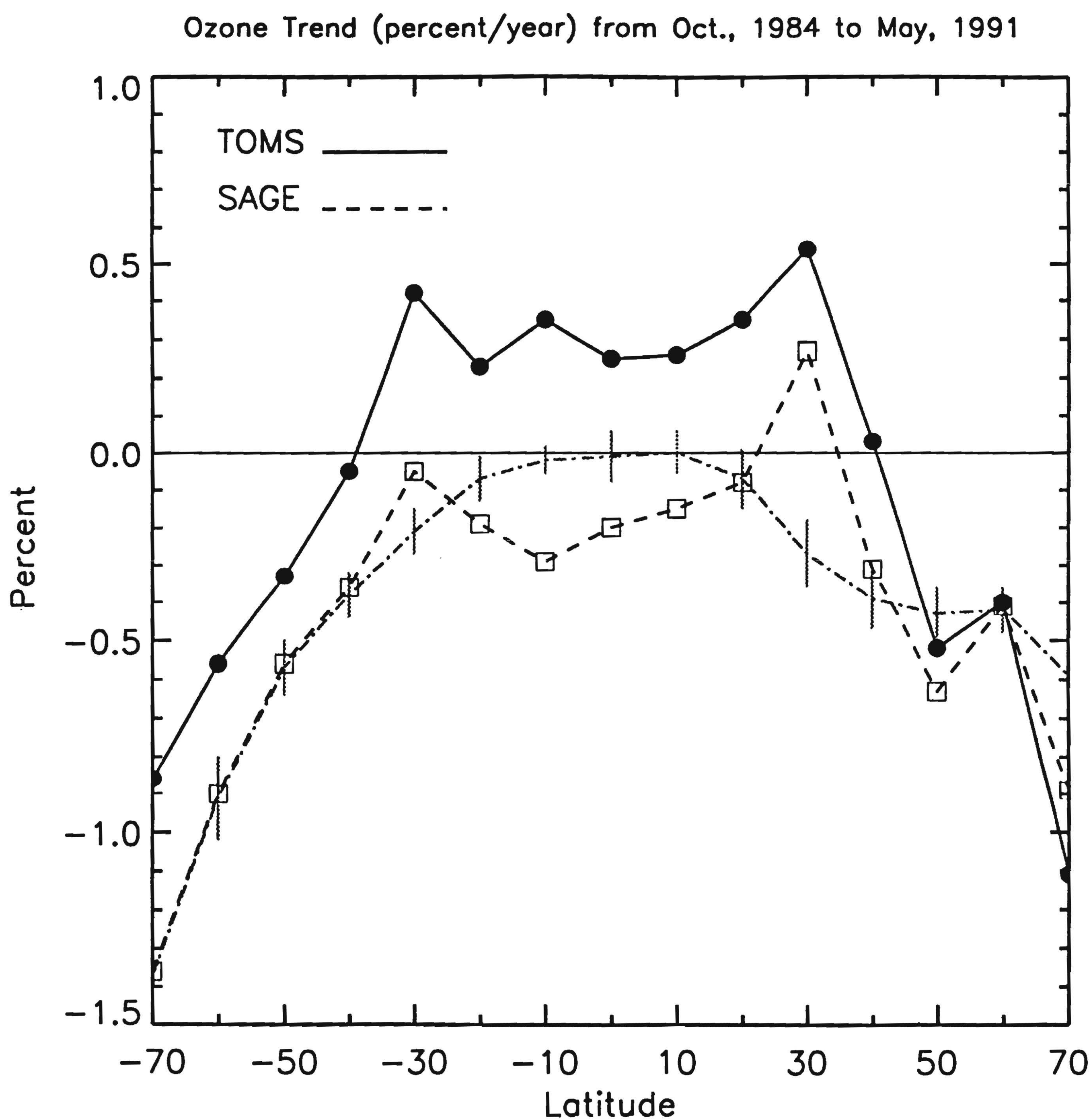
1.5-5


CLAES9/SAGE O3 DIFFERENCE & ERROR
0.1
1.0
10.0
100.0
Pressure (mb)
−75
−50
−25
0
25
50
75
Difference (%)

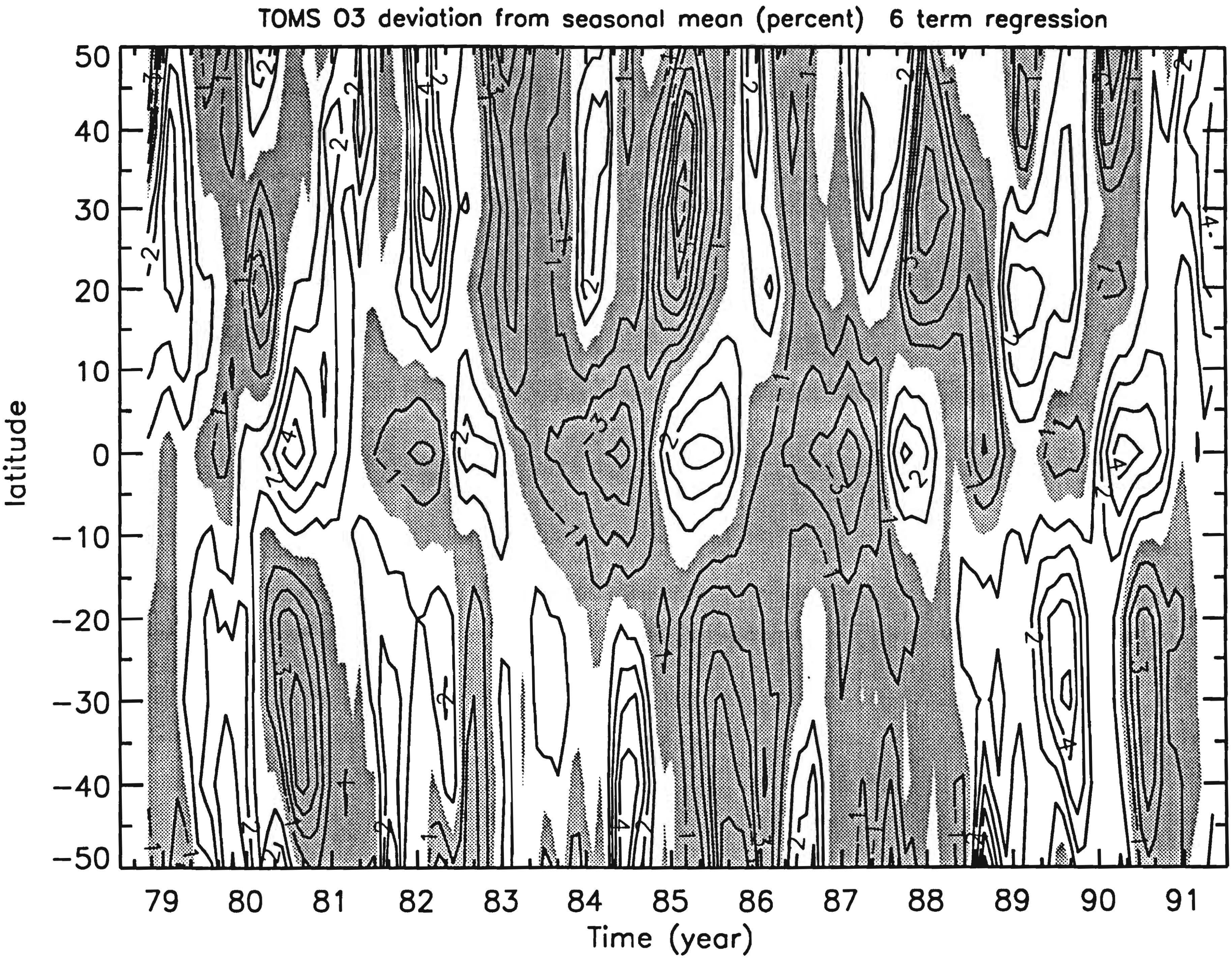

CLAES8/SAGE O3 DIFFERENCE & ERROR
0.1
1.0
10.0
100.0
Pressure (mb)
−75
−50
−25
0
25
50
75
Difference (%)

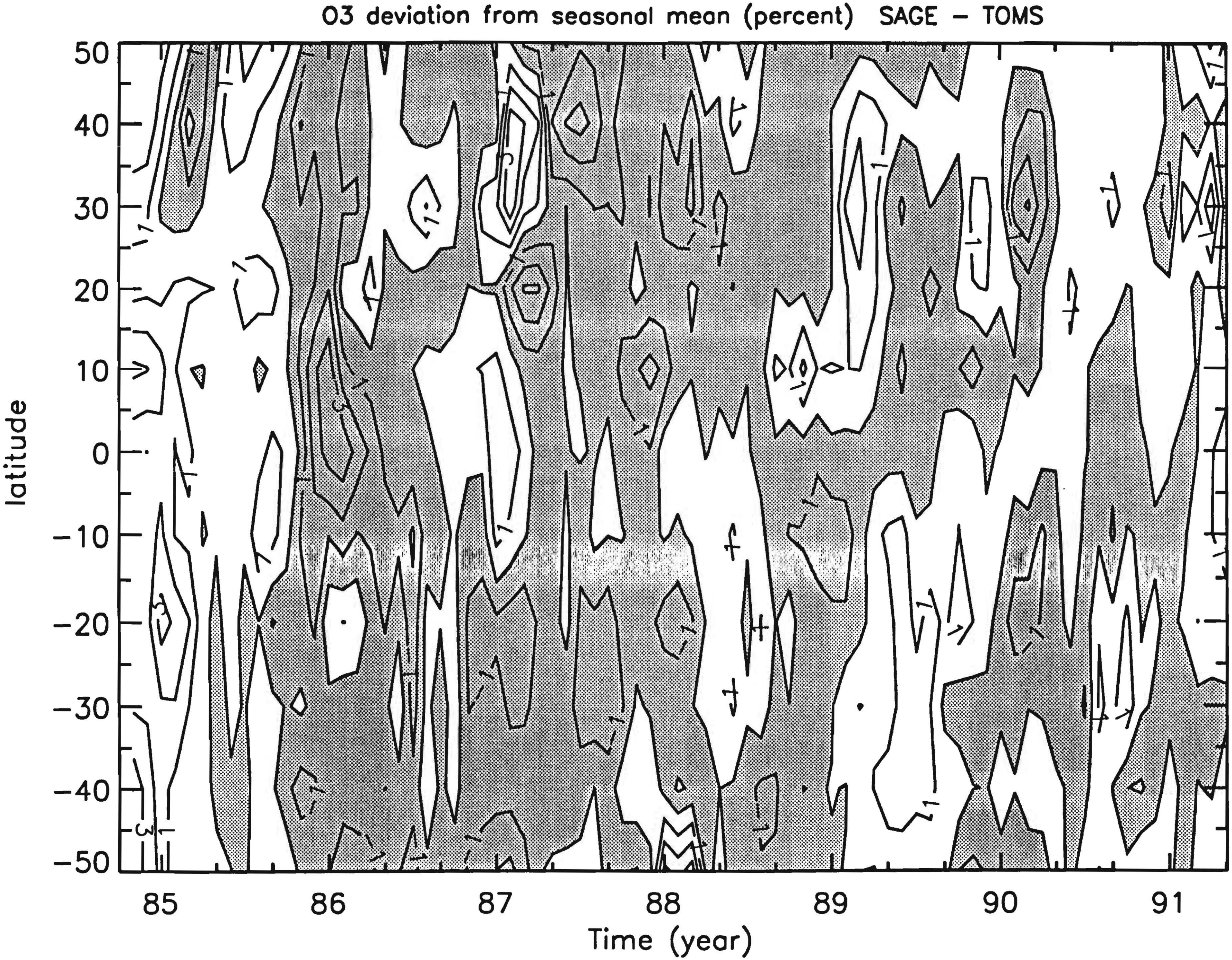
FIGURES ILLUSTRATING

RECENT ACTIVITIES

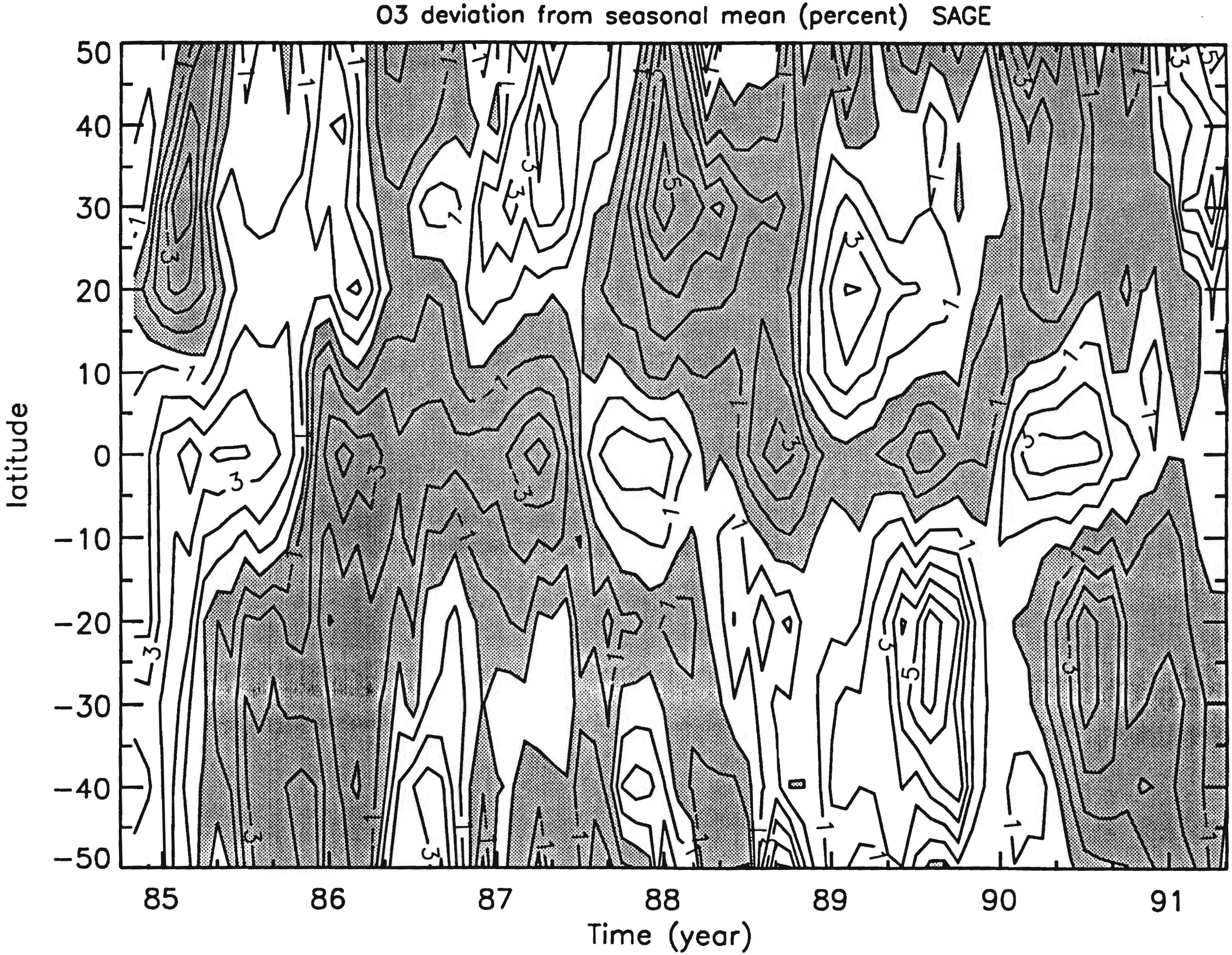


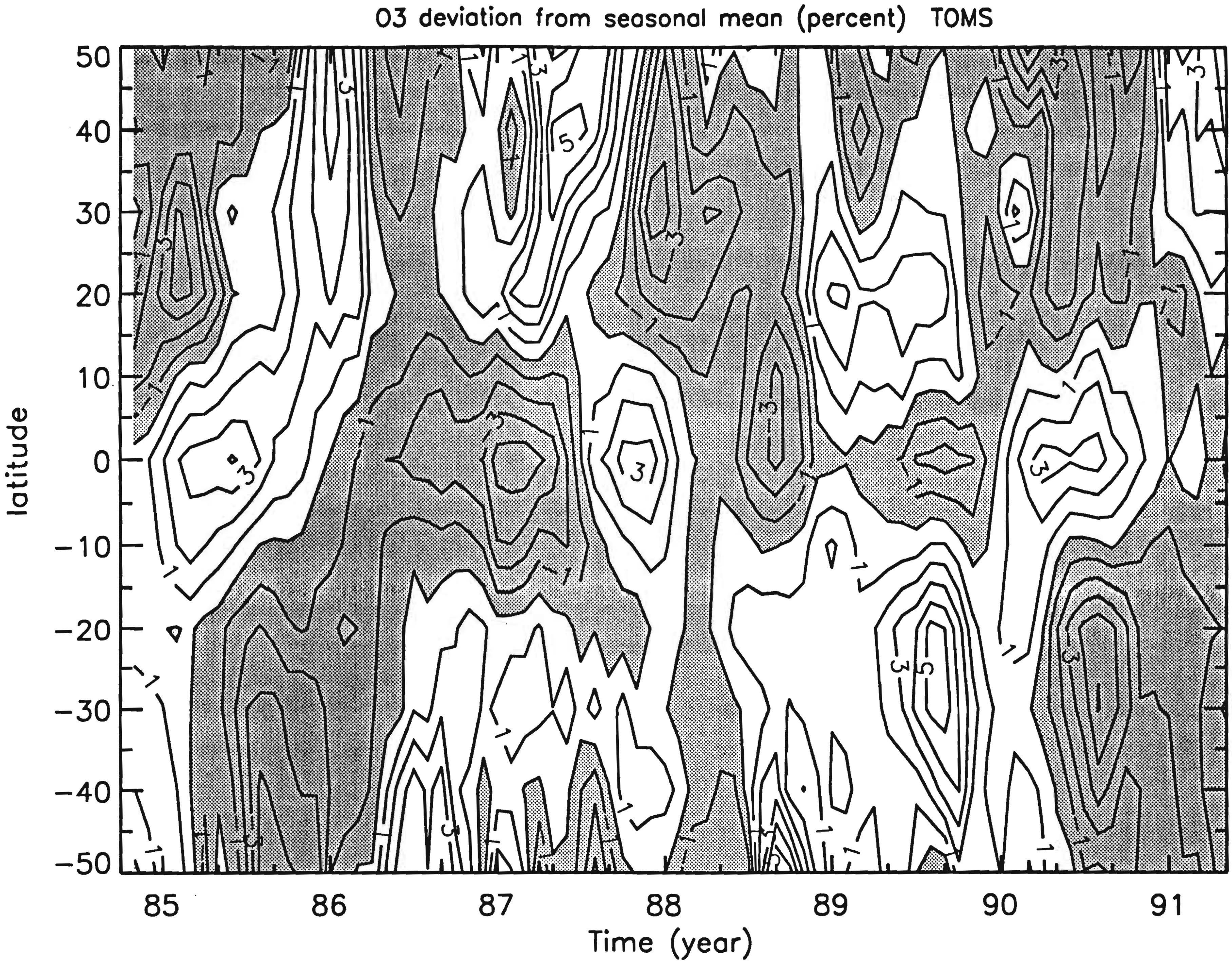
Ozone Trend (percent/year) from Oct., 1984 to May, 1991
TOMS
SAGE
1.0
0.5
0.0
−0.5
−1.0
−1.5
Percent
−70
−50
−30
−10
10
30
50
70
Latitude


TOMS O3 deviation from seasonal mean (percent) 6 term regression
latitude
Time (year)
50
40
30
20
10
0
−10
−20
−30
−40
−50
79
80
81
82
83
84
85
86
87
88
89
90
91

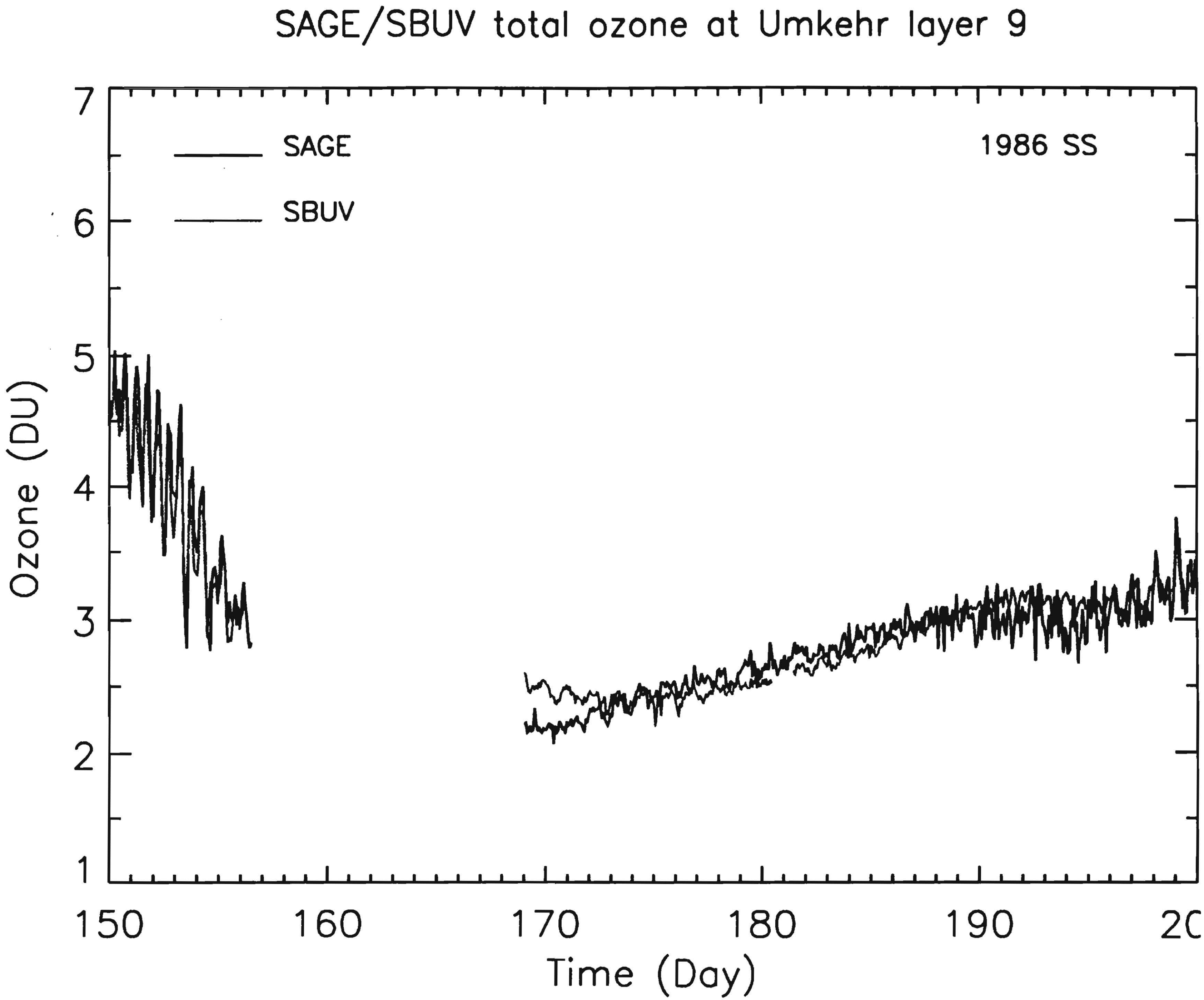


O3 deviation from seasonal mean (percent) SAGE - TOMS
latitude
Time (year)
50
40
30
20
10
0
-10
-20
-30
-40
-50
85
86
87
88
89
90
91

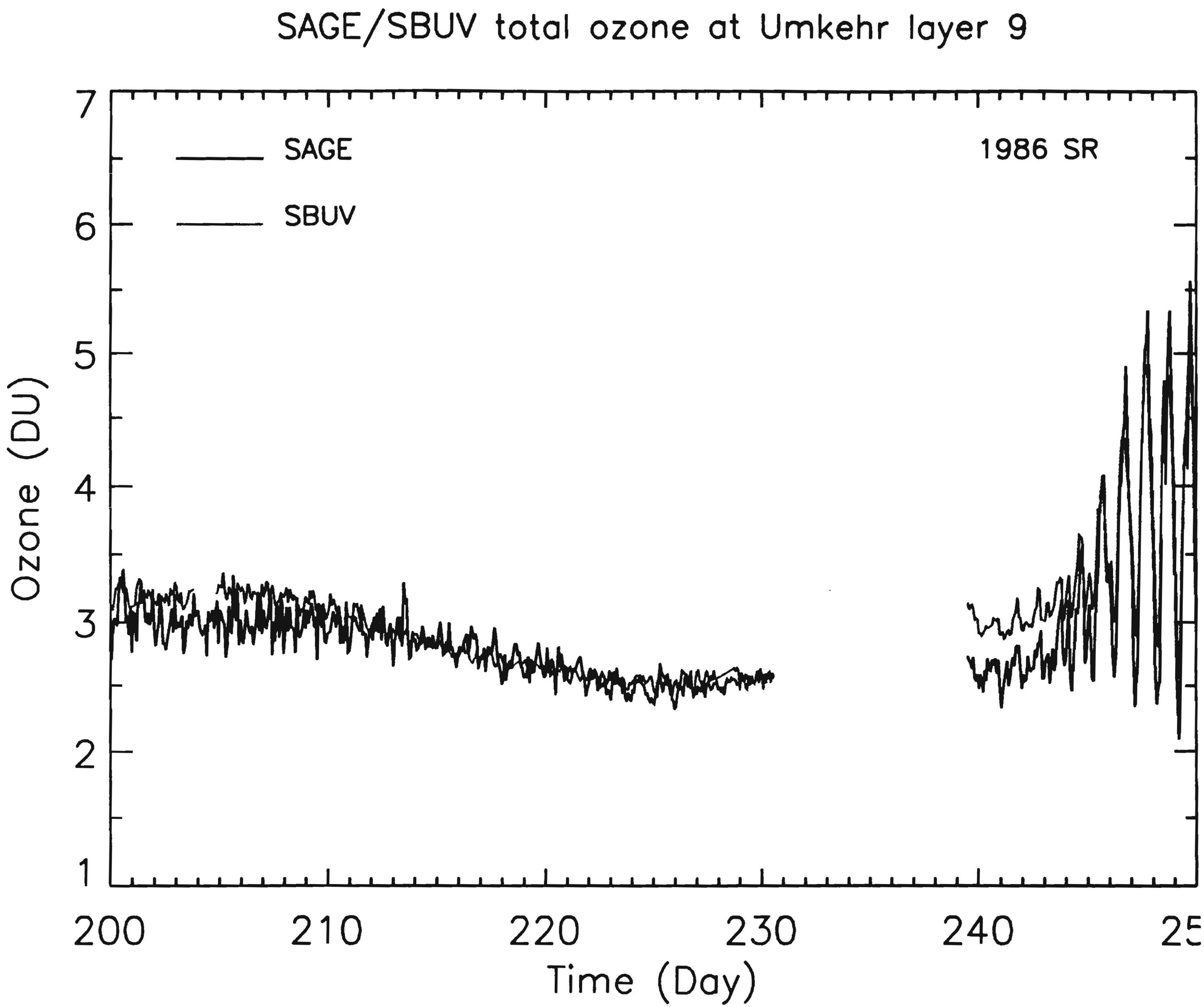

O3 deviation from seasonal mean (percent) SAGE
latitude
50
40
30
20
10
0
-10
-20
-30
-40
-50
85
86
87
88
89
90
91
Time (year)



O3 deviation from seasonal mean (percent) TOMS
latitude
Time (year)
50
40
30
20
10
0
−10
−20
−30
−40
−50
85
86
87
88
89
90
91

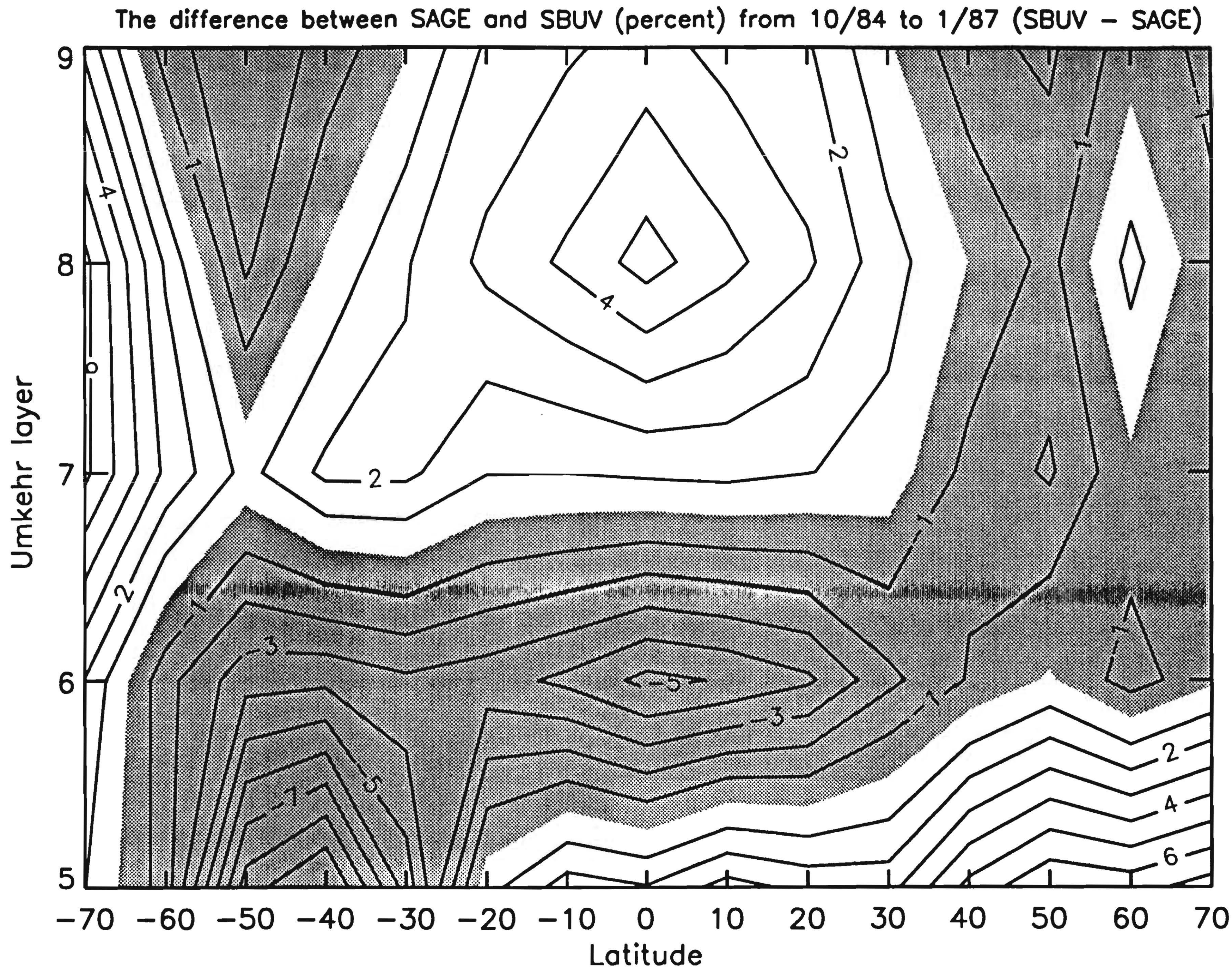


SAGE/SBUV total ozone at Umkehr layer 9
SAGE
SBUV
1986 SS
Ozone (DU)
7
6
5
4
3
2
1
150
160
170
180
190
2C
Time (Day)



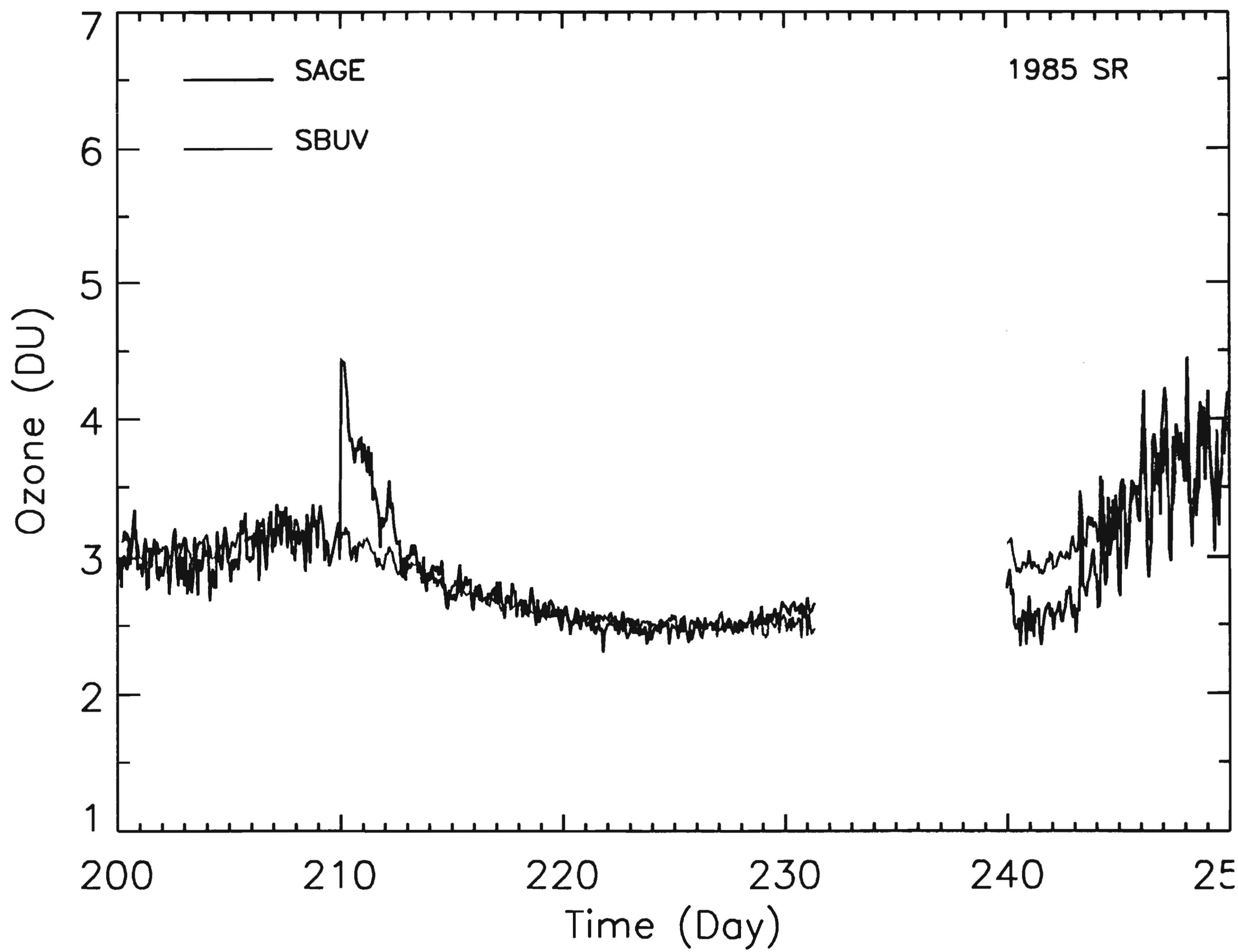
SAGE/SBUV total ozone at Umkehr layer 9
SAGE
SBUV
1986 SR
Ozone (DU)
1
2
3
4
5
6
7
200
210
220
230
240
25
Time (Day)

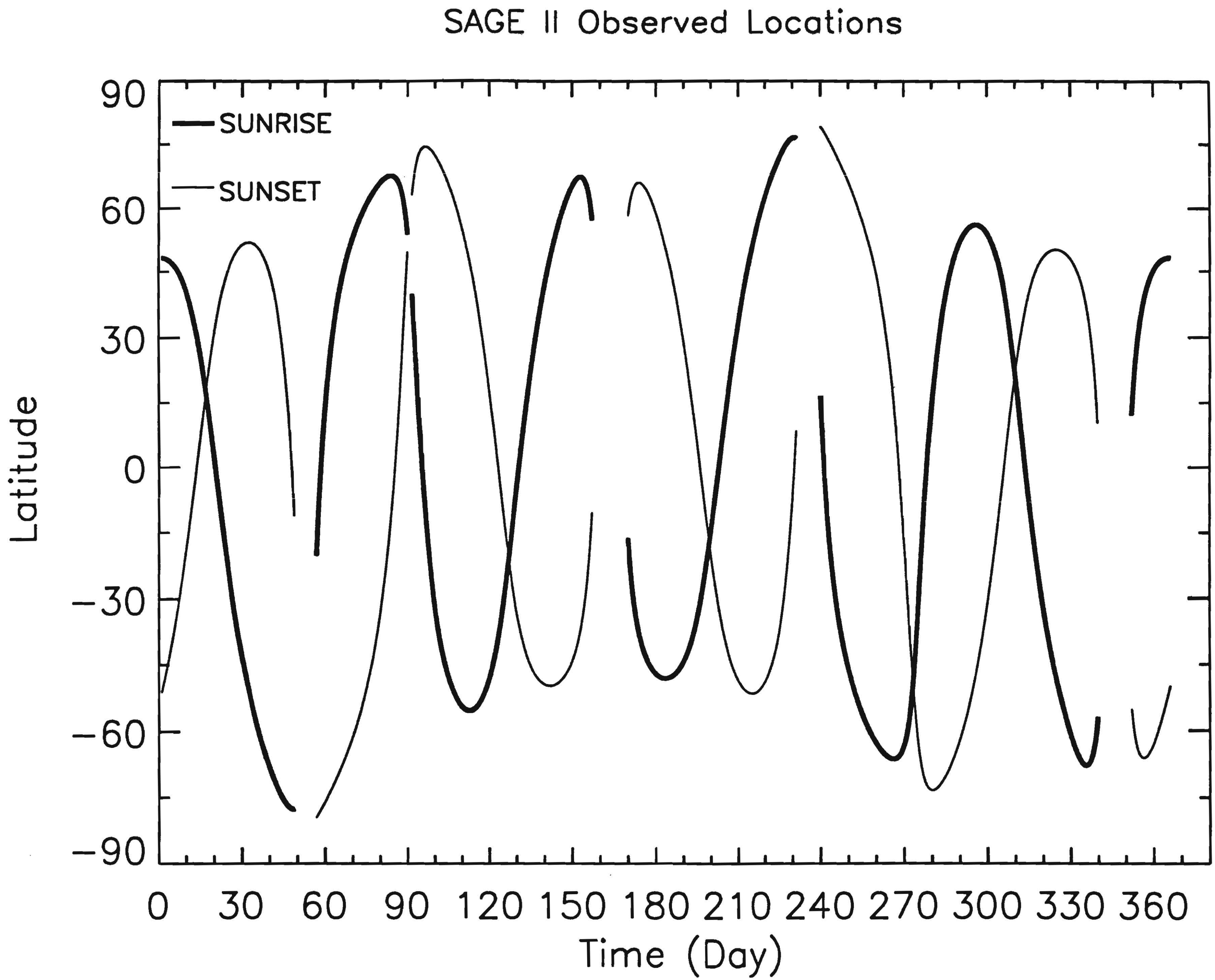
R



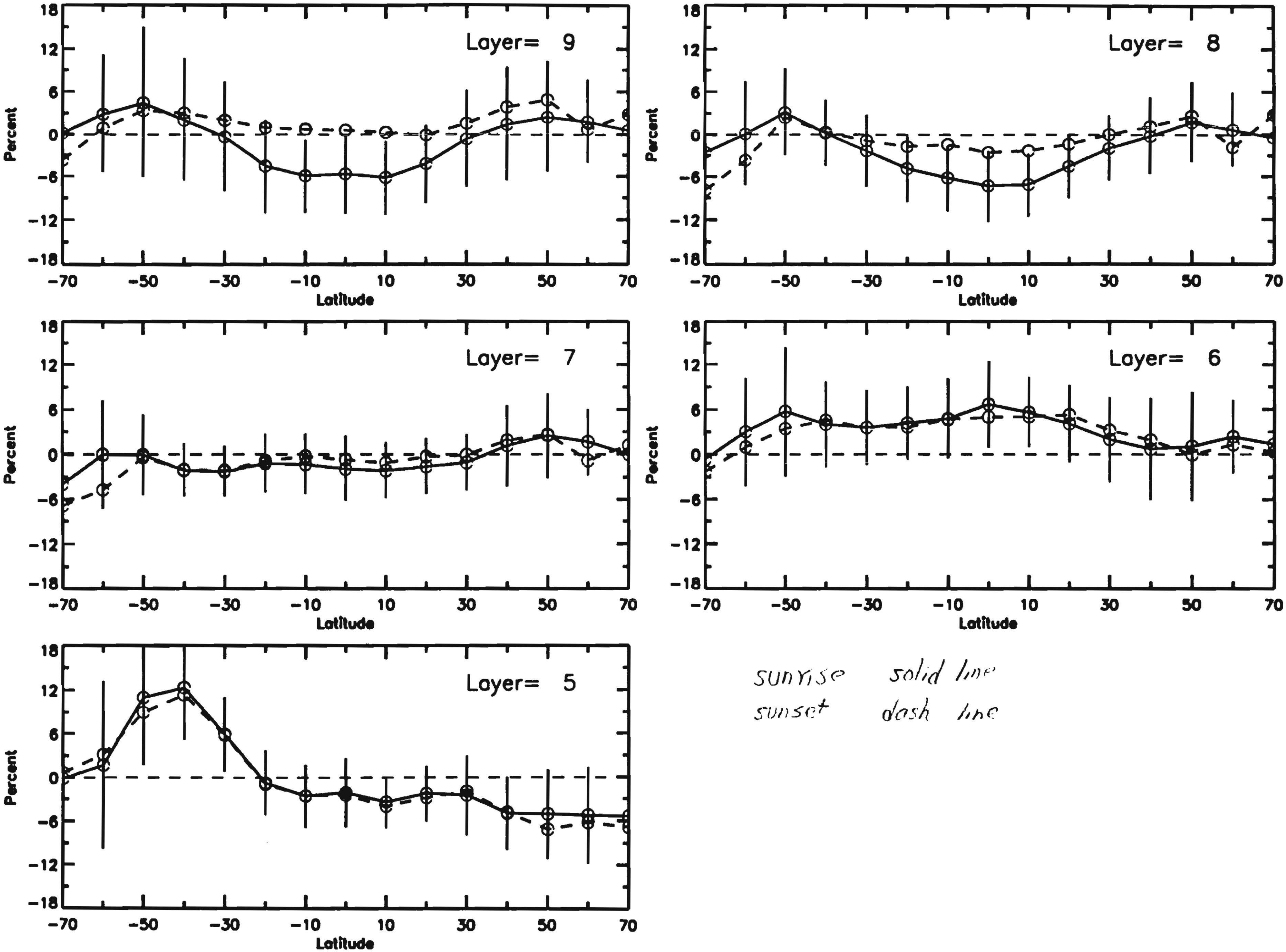
The difference between SAGE and SBUV (percent) from 10/84 to 1/87 (SBUV - SAGE)
Umkehr layer
Latitude
9
8
7
6
5
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70

SAGE/SBUV total ozone at Umkehr layer 9

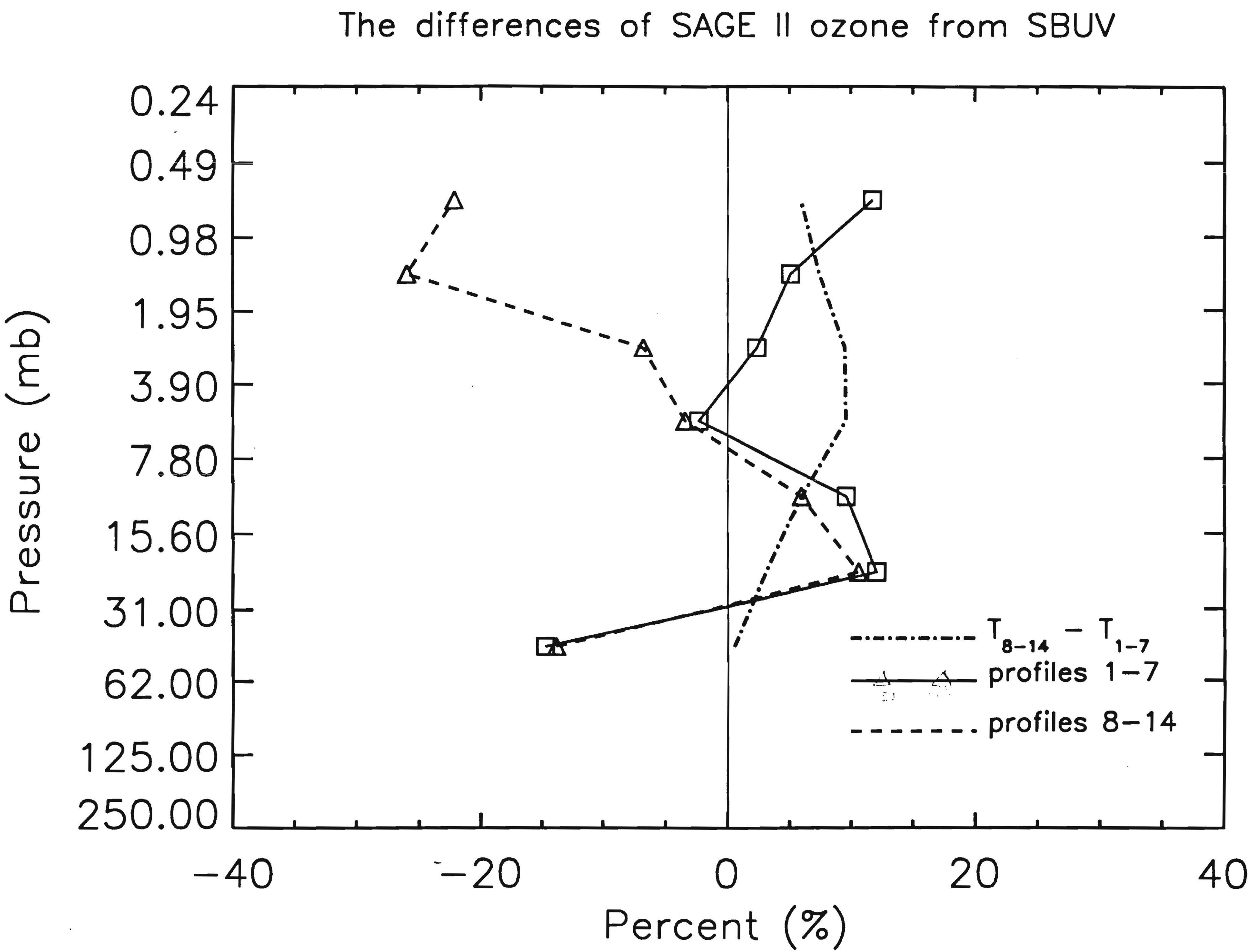


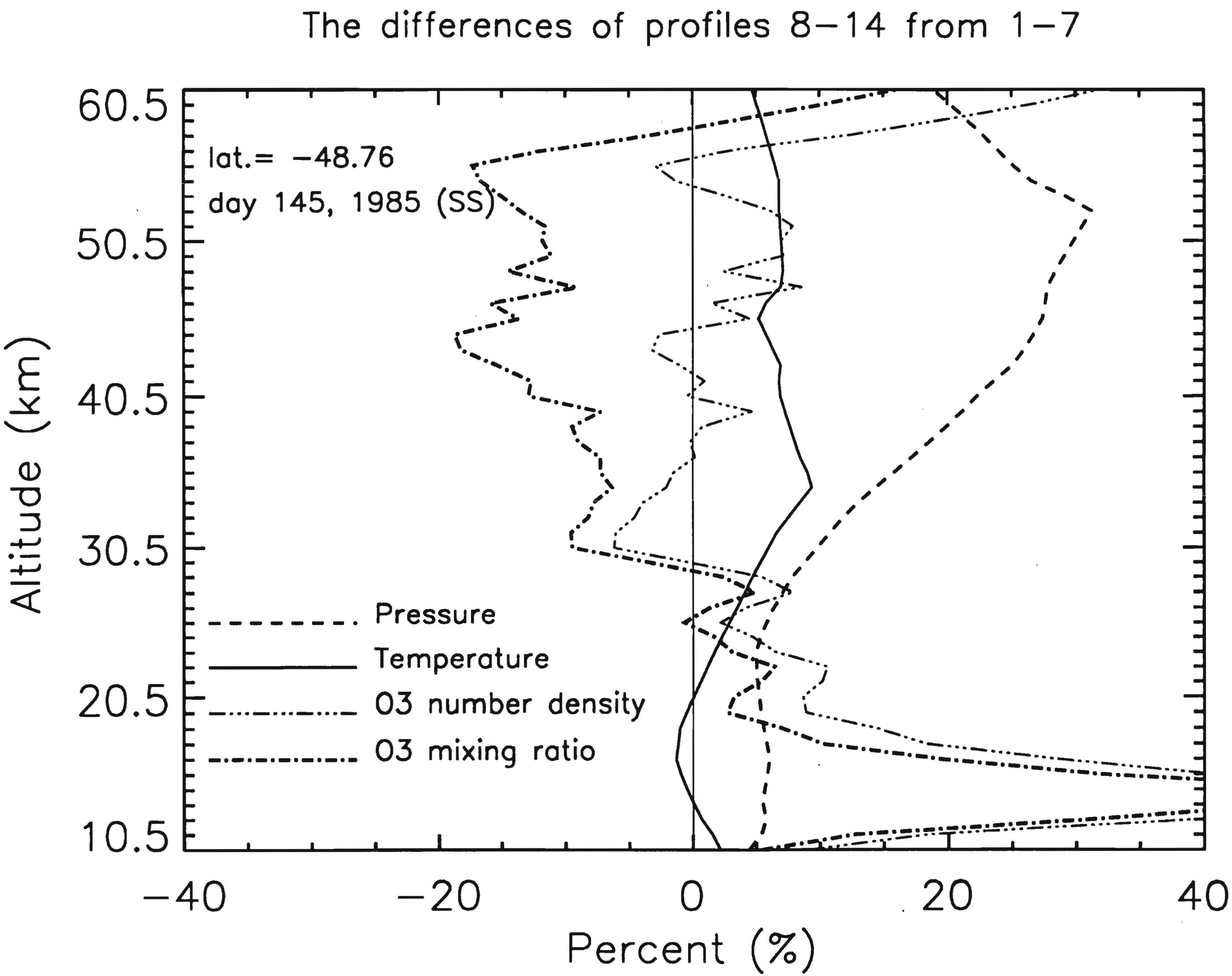

SAGE II Observed Locations
SUNRISE
SUNSET
Latitude
90
60
30
0
−30
−60
−90
0
30
60
90
120
150
180
210
240
270
300
330
360
Time (Day)

(sage - sbuv)/sbuv



sunrise solid line
sunset dash line


The differences of SAGE II ozone from SBUV
Pressure (mb)
0.24
0.49
0.98
1.95
3.90
7.80
15.60
31.00
62.00
125.00
250.00
−40
−20
0
20
40
Percent (%)
$T_{8-14} - T_{1-7}$
profiles 1−7
profiles 8−14

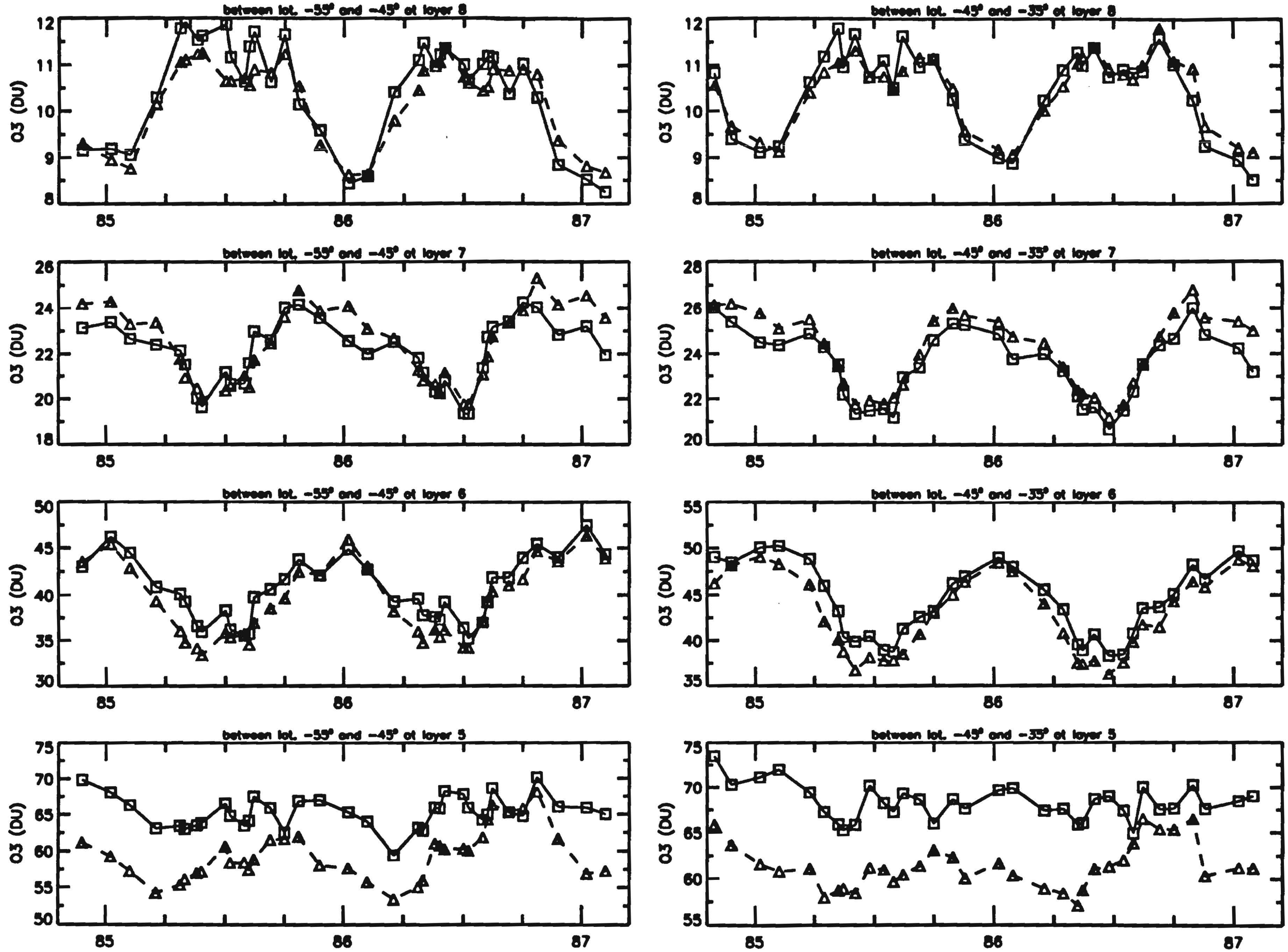


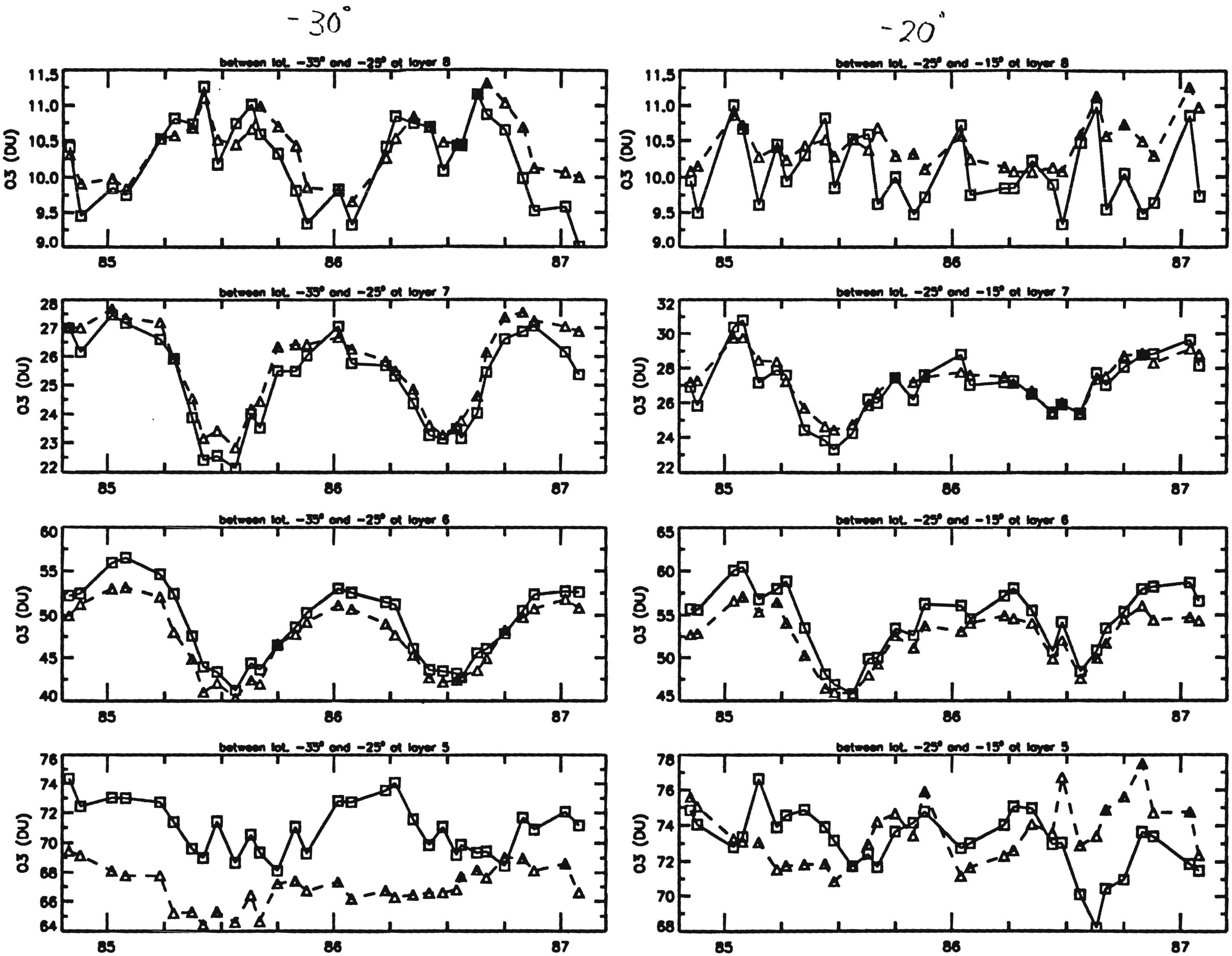
The differences of profiles 8−14 from 1−7
lat.= −48.76
day 145, 1985 (SS)
Pressure
Temperature
03 number density
03 mixing ratio
Altitude (km)
60.5
50.5
40.5
30.5
20.5
10.5
−40
−20
0
20
40
Percent (%)

SAGE vs SBUV

(Full line) (dashed)

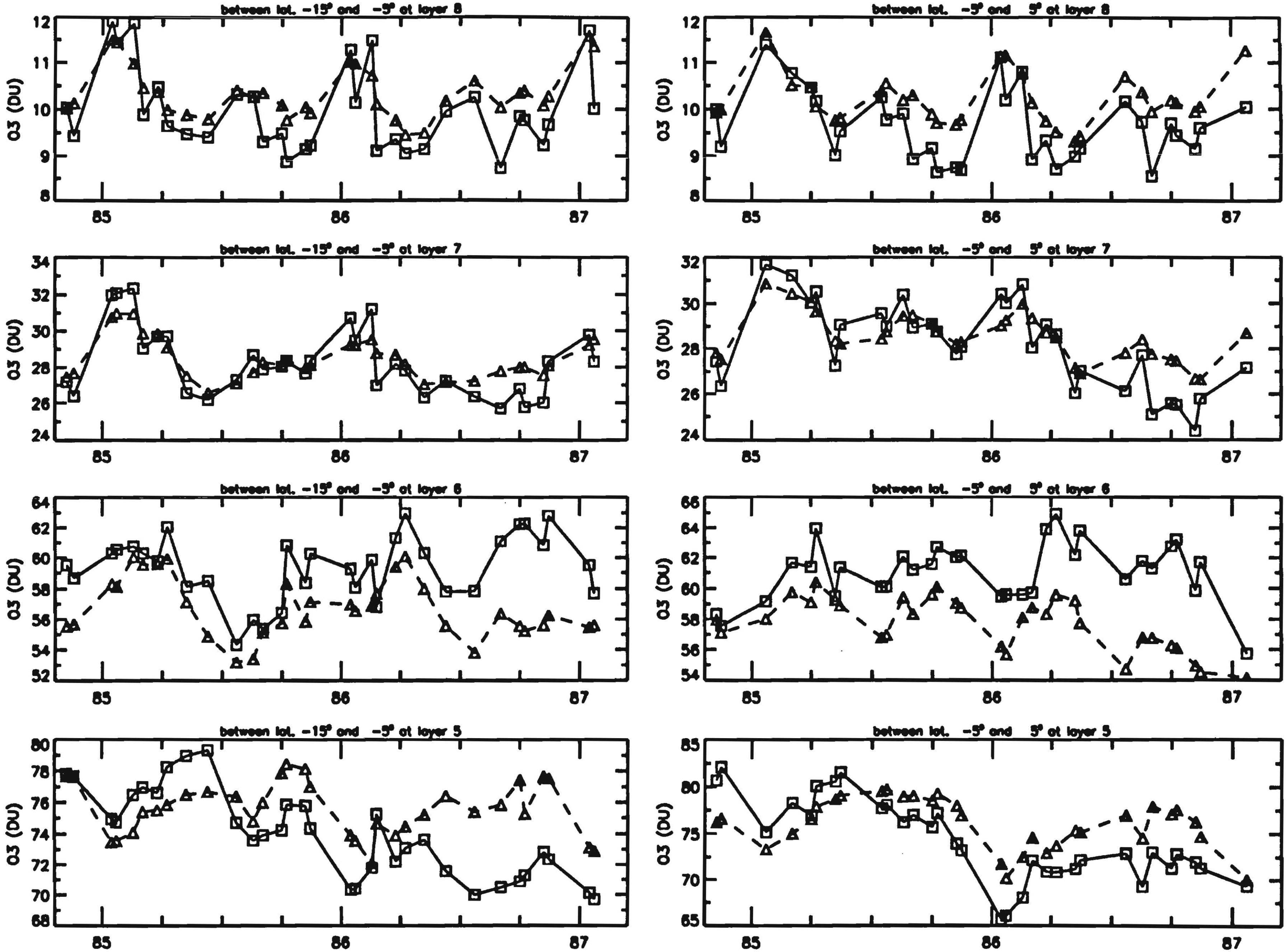
-50° -40°



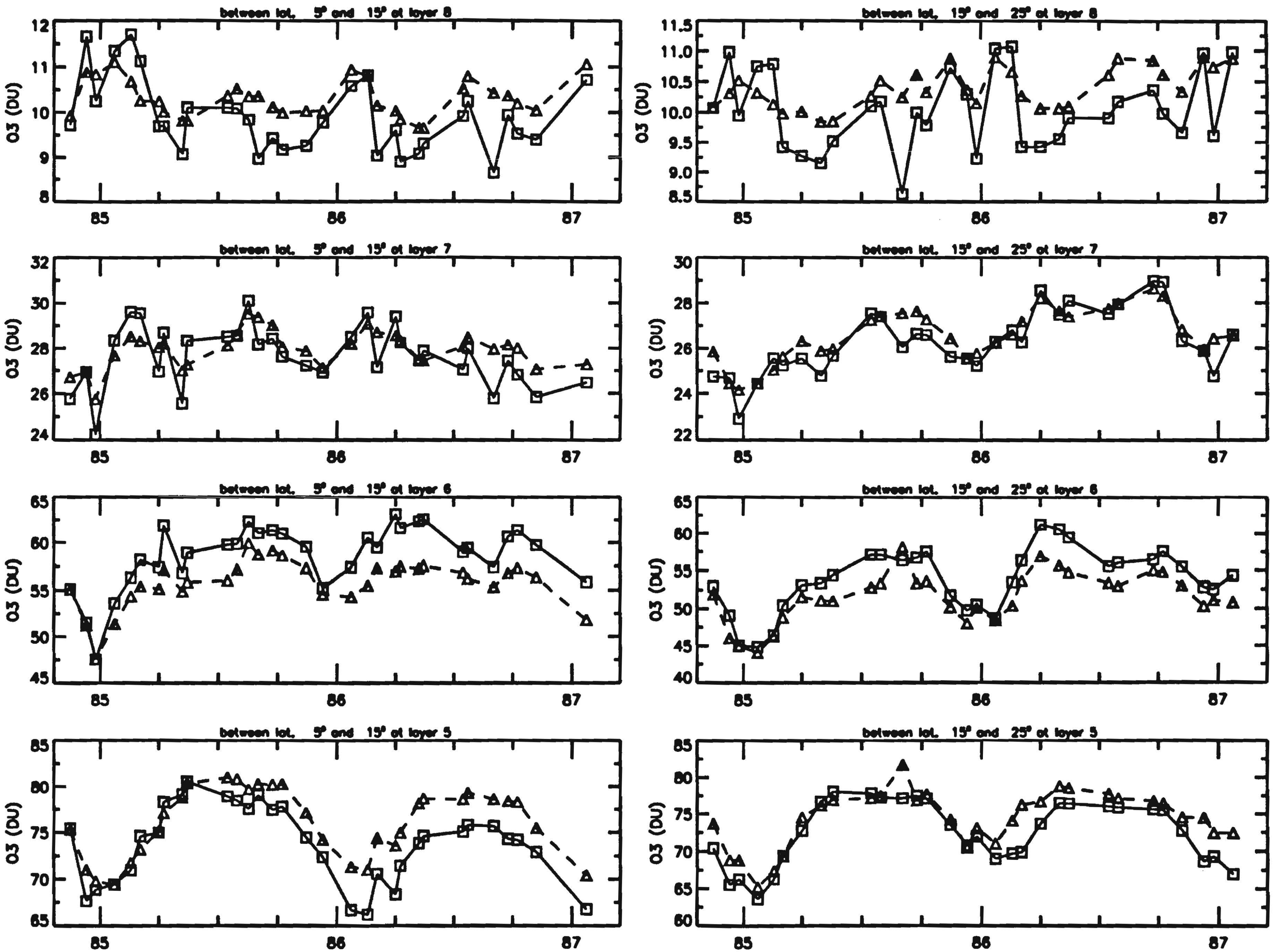


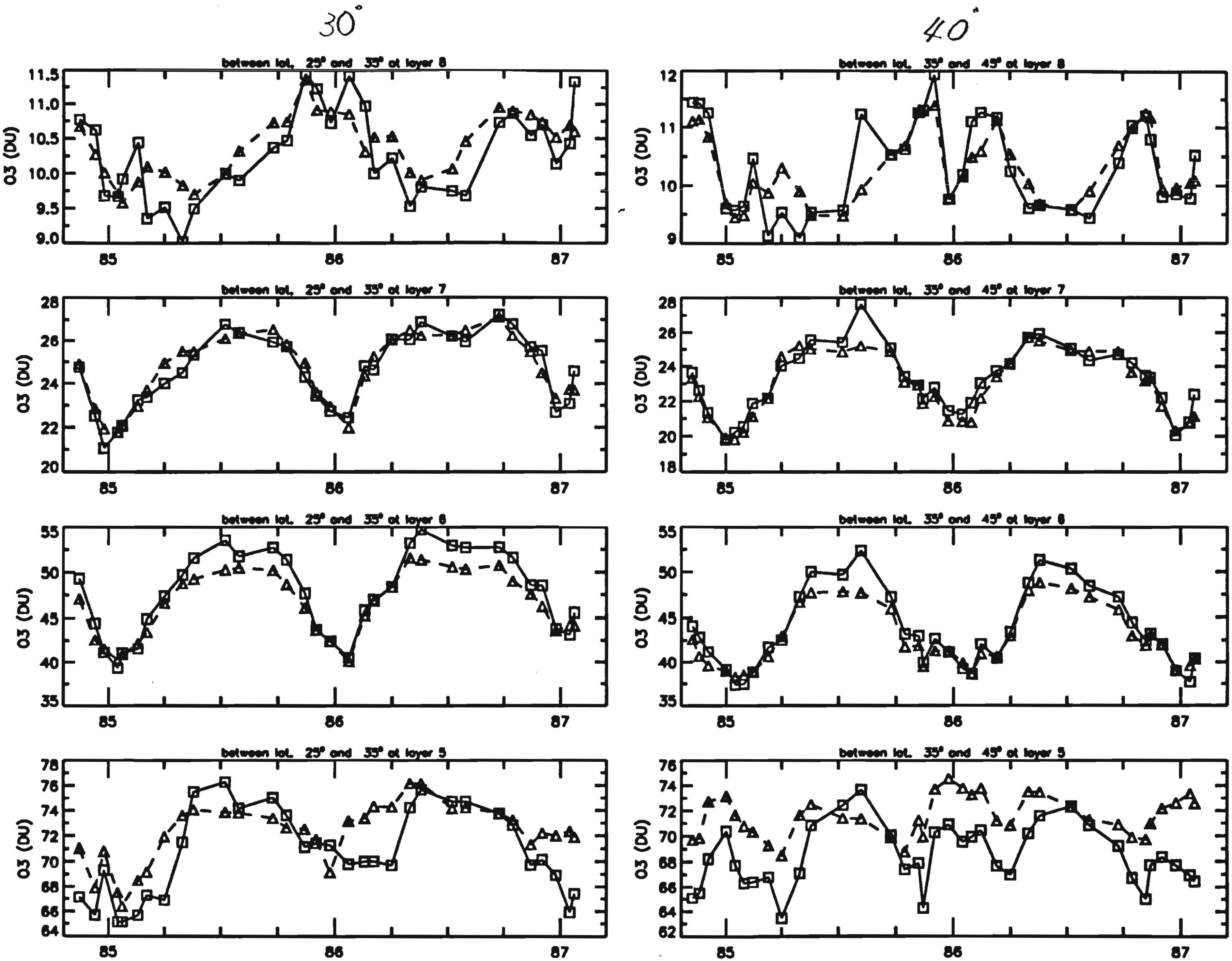
-30°
-20°
between lat. -35° and -25° at layer 8
between lat. -25° and -15° at layer 8
between lat. -35° and -25° at layer 7
between lat. -25° and -15° at layer 7
between lat. -35° and -25° at layer 6
between lat. -25° and -15° at layer 6
between lat. -35° and -25° at layer 5
between lat. -25° and -15° at layer 5
O3 (DU)
85
86
87

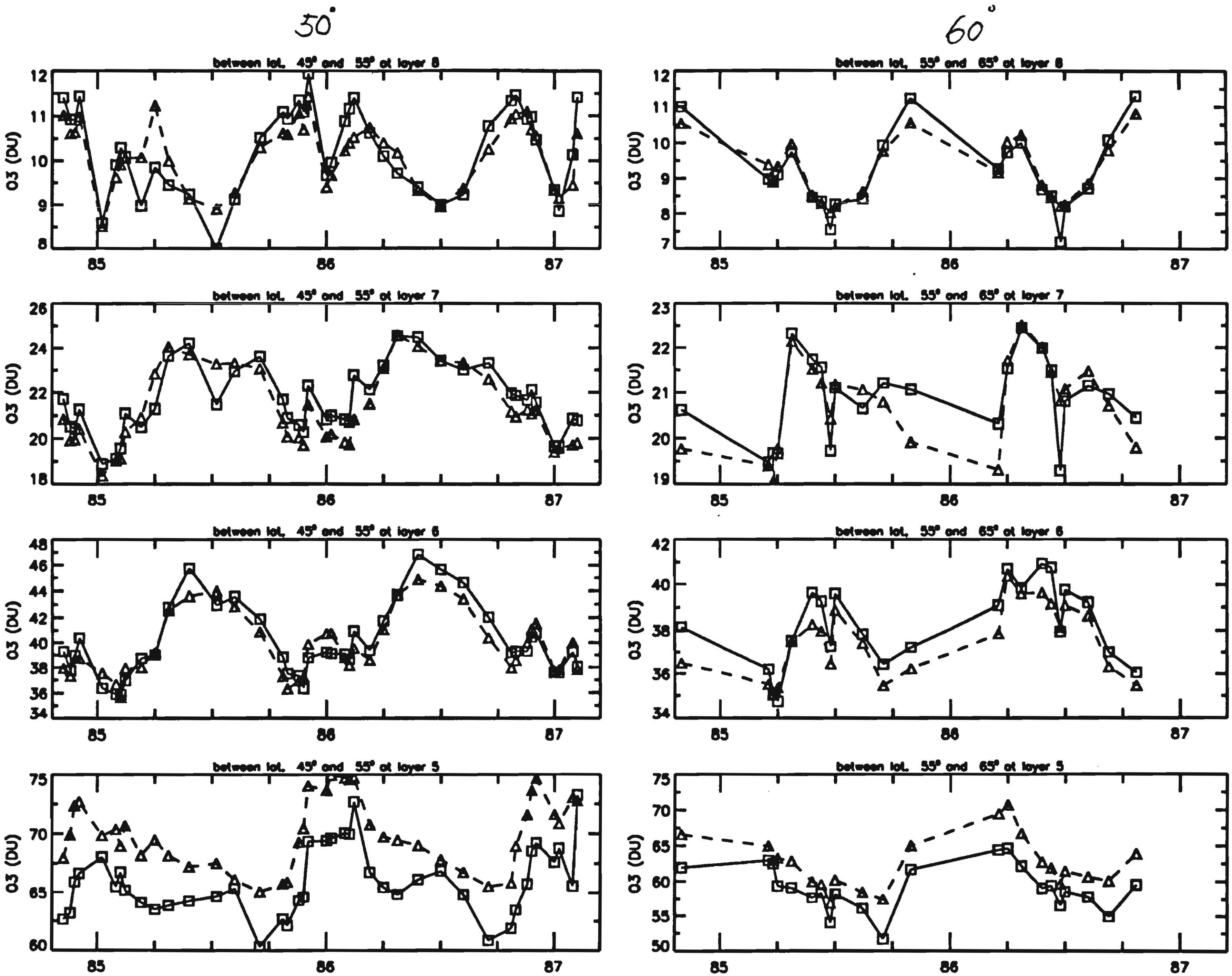
−10°   0°


between lat. −15° and −5° at layer 8
between lat. −5° and 5° at layer 8
between lat. −15° and −5° at layer 7
between lat. −5° and 5° at layer 7
between lat. −15° and −5° at layer 6
between lat. −5° and 5° at layer 6
between lat. −15° and −5° at layer 5
between lat. −5° and 5° at layer 5
O3 (DU)
85
86
87

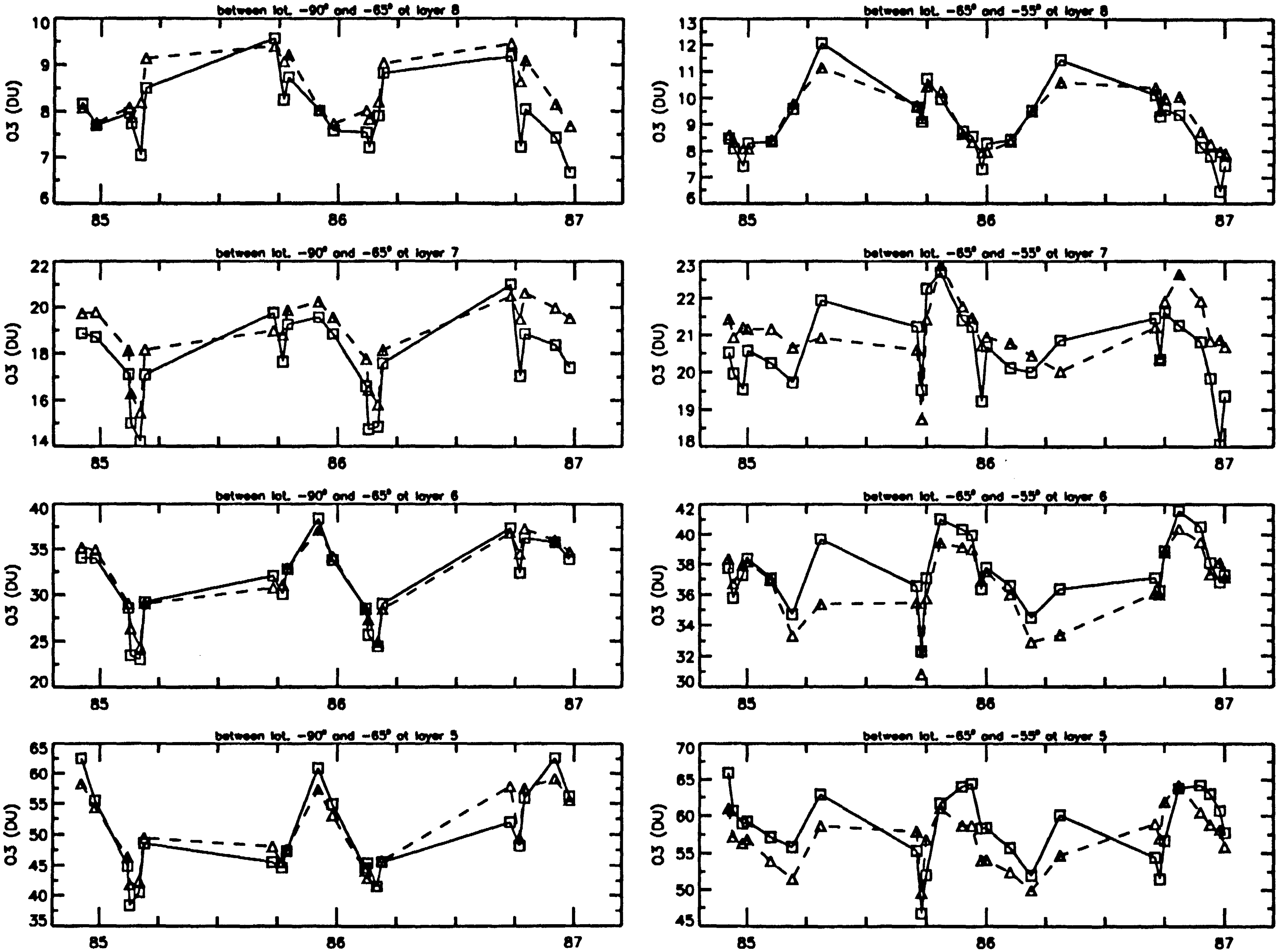
10°	20°


between lat. 5° and 15° at layer 8
between lat. 15° and 25° at layer 8
between lat. 5° and 15° at layer 7
between lat. 15° and 25° at layer 7
between lat. 5° and 15° at layer 6
between lat. 15° and 25° at layer 6
between lat. 5° and 15° at layer 5
between lat. 15° and 25° at layer 5
O3 (DU)
85
86
87


30°
40°
between lat. 25° and 35° at layer 8
between lat. 35° and 45° at layer 8
between lat. 25° and 35° at layer 7
between lat. 35° and 45° at layer 7
between lat. 25° and 35° at layer 6
between lat. 35° and 45° at layer 6
between lat. 25° and 35° at layer 5
between lat. 35° and 45° at layer 5
O3 (DU)
85
86
87


50°
60°
between lat. 45° and 55° at layer 8
between lat. 55° and 65° at layer 8
between lat. 45° and 55° at layer 7
between lat. 55° and 65° at layer 7
between lat. 45° and 55° at layer 6
between lat. 55° and 65° at layer 6
between lat. 45° and 55° at layer 5
between lat. 55° and 65° at layer 5
O3 (DU)
85
86
87

-60°



between lat. -90° and -65° at layer 8
between lat. -65° and -55° at layer 8
between lat. -90° and -65° at layer 7
between lat. -65° and -55° at layer 7
between lat. -90° and -65° at layer 6
between lat. -65° and -55° at layer 6
between lat. -90° and -65° at layer 5
between lat. -65° and -55° at layer 5
O3 (DU)
85
86
87

Ozone Trend (percent/year) from Oct., 1984 to May, 1991